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TO THE

Reports of The Chief of Engineers, U. S. Army (Including the Reports of the Isthmian Canal Commissions, 1899-1914)

1866–1912

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VOLUME II—FORTIFICATIONS, BRIDGES
PANAMA CANAL, ETC.

Completed under the direction of
Brig. Gen. Dan C. Kingman, Chief of Engineers, U. S. Army
By Colonel George A. Zinn, Corps of Engineers
John McClure, Compiler

VOLUME II

FORTIFICATIONS, BRIDGES
PANAMA CANAL, ETC.

February 16, 1914.—Referred to the Committee on Rivers and Harbors and ordered to be printed, with illustrations

WASHINGTON
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1916

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GUIDE TO USE OF INDEX.

Order of subjects.—The subjects considered are classified and appear in the following order:

Rivers and harbors.
Fortifications.
Miscellaneous.
Bridges.
Dams, dolphins, and weirs.
Harbor lines.
Wrecks.
Engineers.
Contractors.
Floating plant.
Appropriations.
Panama Canal.

Arrangement of data.—Rivers and harbors, and fortifications, are arranged in *geographical* order, other data in *special* or *alphabetical* order. Each subject is treated independently of the others.

Subdivisions of subjects.—Lists of titles of such subdivisions appear at the beginning of each subject. Page figures attached to data almost always refer to reports of Chief of Engineers; where they refer to other matter, this is made clear.

Explanatory notes appear at the beginning of each subject, the topical index, and the alphabetical finding lists.

Topical index.—This part of the index covers engineering, physical and miscellaneous information, the *subject names* arranged in alphabetical sequence, and is not otherwise indexed.

Alphabetical finding lists.—Several alphabetical finding lists are provided, as follows:

(a) A general or consolidated finding list for both volumes, at the back of Volume II, forming Part VII of the work, containing the names of important waterways, fortifications, bridges, etc., referred to in both volumes.

(b) A finding list at the back of Volume I, containing the names of waterways listed in Volume I, Part I of this work.

(c) A finding list for each of the following rivers—Ohio, Missouri, Mississippi, and Columbia—immediately preceding the abstracts of those rivers, containing references to each point and section mentioned in the abstracts.

Maps.—A map of the United States divided into districts appears at the beginning of Vol. I and district maps at the beginning of each river and harbor district. There is a map of the Panama Canal in Part V.

Illustrations.—Views of typical classes of construction appear in the topical part under the subject "Construction."

References.—References in all parts of the main index are to year and page of *reports* of the Chief of Engineers, etc., *except* in the alphabetical finding lists, where the paging refers to *this book*. Deviations from this rule are usually embraced in footnotes, or are inclosed in parenthesis.

ABBREVIATIONS.[1]

The following is a list of the more important abbreviations employed:

au.	authority
*	allotment
an.	annual, annually
approx.	approximate
B.	Bay, Board
BE.	Board of Engineers
BERH.	Board of Engineers for Rivers and Harbors
break'r	breakwater
br.	bridge
C.	commerce, commercial
constr.	construction
chan.	channel
¢	cents
cy.	cubic yard
DO.	District Officer or Engineer
dw.	deep water
dr.	dredging
DE.	Division Engineer
e.	east
est.	estimate
estab.	establishment
ex.	examination
expend.	expenditures, expending
Engrs.	Engineers (Chief of Engineers in full)
fav.	favorable
h.	high
H.	Harbor
imp.	improvement
j.	jetty
l.	long, length, lengthening
l. & d.	lock and dam
m.	miles
max.	maximum
misc.	miscellaneous
min.	minimum
mainten.	maintenance, maintaining
mlw.	mean low water
n.	north
obstr.	obstruction
orig.	original
proj.	project
pre.	preliminary
pt.	point
p.	pier
P.	Panama
%	per cent
RR.	railroad
revet.	revetment
R.	(in blackface type) for Report
R.	river
recom.	recommended, recommendations
Sec. War	Secretary of War
SS.	steamboats
s.	south, or supplement
st.	stone
sur.	survey
sq.	square
St.	street
superstr.	superstructure
t.	ton, tonnage
Treas.	Treasury, Treasurer
U.S.	United States, government
unfav.	unfavorable
vol.	volume
w.	west

There are other abbreviations, such as Capt. for Captain, and the like, but all these should require no explanation.

Waterway dimensions are in numerals, in the order of depth and width and length, as 18′ x 100′ x 12 m.

02, S49, means the annual report for 1902, supplement, page 49. **P12**, 403, means the report of the Panama or I. C. Commission for 1912, page 403. (See below.)

PAGE AND VOLUME REFERENCE.

The volume references are in black figures and the page references in ordinary roman. **88**, 786 means the annual reports for 1888, page 786. 1900 is indicated by **00**. The years from 1901 to 1912 are indicated by **01**, **02**, **03**, **04**, **05**, **06**, **07**, **08**, **09**, **10**, **11**, **12**. Some of the earlier references have lower-case i's after them, in which case "i" means the first volume, "ii" the second volume, and so on. R always means Report.

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[1] Not a few instances may be found where words are not abbreviated according to this list. There may be instances where a group of abbreviations might obscure the meaning. In most cases, however, the abbreviations in the list are employed.

PAGING OF THE ANNUAL REPORTS.

Table showing what page ends each part of the annual reports of the Chief of Engineers, U. S. Army, from 1866 to 1912.

Year.	Part 1.	Part 2.	Part 3.	Part 4.	Part 5.	Part 6.	Part 7.	Part 8.
1866..................	[a] 1–58	[a] 1–238	[a] 1–40	[a] 1–336	....	....	....	....
1867..................	867	....	....	....	....	....	....	....
1868..................	1200	....	....	....	....	....	....	....
1869..................	650	....	....	....	....	....	....	....
1870..................	631	....	....	....	....	....	....	....
1871..................	1030	....	....	....	....	....	....	....
1872..................	1174	....	....	....	....	....	....	....
1873..................	1249	....	....	....	....	....	....	....
1874..................	897	[b] 1–633	....	....	....	....	....	....
1875..................	982	[b] 1–1245	....	....	....	....	....	....
1876..................	767	[b] 1–700	[b] 1–755	....	....	....	....	....
1877..................	836	1455	....	....	....	....	....	....
1878..................	840	1354	1883	....	....	....	....	....
1879..................	950	1890	2399	....	....	....	....	....
1880..................	1047	1873	2556	....	....	....	....	....
1881..................	1042	1898	2877	....	....	....	....	....
1882..................	1068	1908	2856	....	....	....	....	....
1883..................	1045	1960	2413	....	....	....	....	....
1884..................	886	1530	2406	2903	....	....	....	....
1885..................	916	1660	2533	3032	....	....	....	....
1886..................	800	1392	2170	....	....	....	....	....
1887..................	962	1735	2525	3152	....	....	....	....
1888..................	753	1417	2190	2941	....	....	....	....
1889..................	845	1533	2208	2880	....	....	....	....
1890..................	1035	1818	2884	3718	....	....	....	....
1891..................	975	1489	1943	2666	3305	3948	....	....
1892..................	1003	1958	2885	3545	Atlas.	....	....	....
1893..................	1140	1793	2649	3544	3919	4404	....	....
1894..................	826	1332	2008	2696	3074	3591	....	....
1895..................	1020	1724	2525	3070	3615	3956	4301	....
1896..................	680	1338	2060	2672	3401	4196	....	....
1897..................	1190	1876	2648	3508	3835	4225	....	....
1898..................	1074	1686	2414	3135	3458	3855	....	....
1899..................	1206	2045	2724	3290	3653	4002	....	....
1900..................	1072	1792	2306	2906	3946	4524	5006	5535
1901..................	986	1750	2596	3462	3938	[c] [d] 1–428	....	....
1902..................	991	1876	2565	3265	[c] [d] 1–215	....	....	....
1903..................	1026	1885	2370	3012	[c] 1–318	....	....	....
1904*..................	1362	2403	3580	4315	[c] 1–298	....	....	....
1905..................	1234	2239	3036	[c] 1–300	....	....	....	....
1906..................	1432	2609	....	....	....	....	....	....
1907..................	962	1866	2768	....	....	....	....	....
1908..................	1253	2168	2833	....	....	....	....	....
1909..................	1271	2161	2845	....	....	....	....	....
1910..................	1374	2338	3110	....	....	....	....	....
1911..................	1314	2506	3365	....	....	....	....	....
1912..................	1404	2882	3968	....	....	....	....	....

[a] Bound with the three other parts into one volume.
[b] Each part begins with page No. 1.
[c] Mississippi River Commission.
[d] Includes Missouri River Commission Reports.
* After this date there is a noticeable compression of volumes, due to less work on fortifications and to issue of reports on examination and surveys as congressional documents.

PART II.

FORTIFICATIONS.

NOTE.—The special and necessary form of the fortification reports is such that probably no two persons would index them alike in detail. This index will, however, be clearly intelligible to those who have charge of the works referred to.

GUIDE TO THE USE OF PART II.

1. **Alphabetical finding list.**
2. **Order of arrangement of the data.**
3. **Explanation of subheads employed.**

1. ALPHABETICAL FINDING LIST AT THE BACK OF THIS INDEX.

There is a general finding list at the back of this book, made up of names of the various localities named throughout this index, including, of course, the names of places at which fortification work has been done. Under each name of a locality reference is made to the pages of this index on which data pertaining to the place named will be found. The first page of the finding-list presents details explaining further the uses of the finding list.

2. ORDER OF ARRANGEMENT OF FORTIFICATION DATA.

The data concerning fortifications, as found in the reports of the Chief of Engineers, are, in this index, arranged under the following two heads or classes:

Section 1. General data, arranged according to table below.

Section 2. Fortification works, arranged according to geographical situation (see table below).

SECTION 1—GENERAL DATA.

NOTE.—A combination of symbolic letters is given each related group of facts concerning fortifications. This is done for convenience in making reference and in arranging details.

The first letter is always F. This letter is the initial of "fortifications."

The second letter may be any one of the following:

M for Miscellaneous.
N for North Atlantic works.
S for South Atlantic works.
G for Gulf of Mexico works.
L for Great Lakes works.
P for Pacific coast works.
O for Insular or Oversea.

The third or the third and fourth letters refer to the waterways district in which the defenses are situated, and hence to the office in charge. (See frontispiece map.) An exception is made in the case of FM data, the third letter indicating sequence only.

Illustration: FMD means "fortifications," "miscellaneous data" concerning "preservation or repair," which is fourth or D in the list of general data.

Illustration: FNH refers to "fortifications," "North Atlantic Group," waterways district H.

Illustration: FPSS refers to "fortifications," "Pacific coast," waterways district SS.

MISCELLANEOUS.

FMA	Appropriations.
FMB	Boards.
FMC	Operations, general.
FMD	Preservation and repair.
FME	Range and position finders, and fire control.
FMF	Searchlights and electrical equipment.
FMG	Sites, batteries, and emplacements.
FMH	Supplies.
FMI	Torpedoes and mining.
FMJ	Sea walls and embankments.

SECTION 2—FORTIFICATION WORKS.

North Atlantic works:

FNA	Maine and New Hampshire Group.
FNB	Boston Group.
FNC	Massachusetts and Rhode Island Group.
FND	Connecticut Group.
FNF	New York City Group.
FNH	Delaware River Group.

South Atlantic works:

FSJ	Baltimore Group.
FSK	Washington Group.
FSL	Hampton Roads Group.
FSM	North Carolina Group.
FSN	South Carolina Group.
FSO	Georgia Group.

Gulf of Mexico works:

FGP	East and south Florida and Tampa Group.
FGQ	Pensacola Group.
FGR	Mobile and Mississippi Sound Group.
FGS	New Orleans and Sabine Pass Group.
FGU	Galveston Group.

Great Lakes works:

FLPP	Detroit Group.
FLRR	Buffalo Group.

Pacific coast works:

FPSS	San Diego Group.
FPTT*	San Francisco Group.
FPWW	Columbia River Group.
FPXX	Puget Sound Group.

Oversea works:

FOPR	Porto Rico Group.
FOPI	Philippines Group.
FOHI	Hawaiian Group.
FOPC	Panama Canal or Isthmian America.

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* In charge of a special office.

3. EXPLANATION OF SUBHEADS.

NOTE.

The names of centers of coast defense are arranged in groups in geographical order as shown in section 2, p. 1796 of this index.

Under each name the following subheads are arranged in the order in which they are placed below, and the data pertaining to each of these subheads are given in historical order, except in the case of engineering features, the latter being arranged alphabetically.

Contracts.—Important contracts, etc., the more important articles, prices, quantities, being mentioned.

Engineers.—Subdivided into: References to reports of the Chief of Engineers; Boards and their duties; Engineers in charge, showing term of service; Assistants.

Engineering features.—Cost of work, electric installations, arrangement of plant, these and other data under this head being arranged in alphabetical order.

Forts and batteries.—Such works are arranged separately in the order of mention. Under each work brief abstracts of operations by years are given.

Miscellaneous.—References to data not coming properly under the other subheads.

Preservation and repair.—References to work relating to preservation and repair.

Range and position finders.—Important items concerning these instruments.

Sea walls and embankments.—The more important data relating to these structures.

Sites.—Acquisition, lease, sale, etc., of sites.

Submarine mines.—Data relating to torpedo casemates, storehouses, cable tanks, searchlights, etc.

FORTIFICATIONS.

SECTION I.—INDEX TO GENERAL DATA.

FMA APPROPRIATION.

FMB BOARDS.

FMC OPERATION—GENERAL.

FMD PRESERVATION AND REPAIR.

FME RANGE AND POSITION FINDER AND FIRE CONTROL.

FMF SEARCHLIGHTS AND ELECTRICAL EQUIPMENT.

FMG SITES, BATTERIES, AND EMPLACEMENTS.

FMH SUPPLIES.

FMI TORPEDOES AND MINING.

FMJ SEA WALLS AND EMBANKMENTS.

FMA. APPROPRIATIONS.

Part.	Title.
1	Appropriation, by States, etc., and by years.
2	Summary of totals for States.

Part 1, FMA. Appropriations by States, Forts, etc., and by years.

ALABAMA:		
Fort Gaines—		
1825–60		$453,947.78
Fort Morgan, Mobile Point—		
1821–56	$1,317,251.00	
Feb. 10, 1875	25,000.00	
		1,342,251.00
Total		1,796,198.87
ARKANSAS:		
Fort Smith—		
1836–44		152,707.71
CALIFORNIA:		
San Francisco, defenses of (See Batteries, Pneumatic, under Miscellaneous)—		
1853–65	1,027,000.00	
Mar. 2.1889	22,000.00	
		1,049.000.00
Fort Alcatraz—		
1854–65	1,295,000.00	
June 12, 1866	90,000.00	
Mar. 2, 1867	50,000.00	
July 11, 1870	50,000.00	
Mar. 3, 1871	75,000.00	
June 10, 1872	42,500.00	
Feb. 21, 1873	50,000.00	
Apr. 3, 1874	20,000.00	
Feb. 10, 1875	25,000.00	
		1,697,500.00
Fort at Fort Point—		
1854–65	2,012,500.00	
June 12, 1866	125,000.00	
Mar. 2, 1867	25,000.00	
July 11, 1870	100,000.00	
Mar. 3, 1871	50,000.00	
June 10, 1872	85,000.00	
Feb. 21, 1873	65,000.00	
Apr. 3.1874	30,000.00	
Feb. 10, 1875	25,000.00	
		2,517,500.00
Fort at Lime Point—		
June 12, 1866	75,000.00	
Mar. 2, 1867	25,000.00	
July 11, 1870	100,000.00	
Mar. 3, 1871	100,000.00	
June 10, 1872	75,000.00	
Feb. 21, 1873	75,000.00	
Apr. 3, 1874	30,000.00	
Jan. 10, 1875	20,000.00	
		500,000.00

CALIFORNIA—Continued.		
Fort at San Diego—		
Feb. 21, 1873		$30,000.00
Yerba Buena Island—		
Feb. 24, 1891		16,000.00
Total		5,830,000.00
CONNECTICUT:		
Fort Griswold—		
1841–42		15,000.00
Fort Hale—		
1865		50,000.00
Fort Trumbull—		
1833–50	$250,400.00	
Apr. 3, 1874	25,000.00	
Feb. 10, 1875	20,000.00	
		295,400.00
Total		360,400.00
DELAWARE:		
Fort Delaware—		
1821–63	2,041,208.98	
July 11, 1870	37,000.00	
Apr. 3, 1874	25,000.00	
		2,103,208.98
Fort opposite Fort Delaware—		
1862	200,000.00	
Mar. 3, 1871	50,000.00	
June 10, 1872	42,500.00	
Feb. 21, 1873	35,000.00	
Apr. 3, 1874	30,000.00	
Feb. 10, 1875	25,000.00	
		382,500.00
Total		2,485,708.98
DISTRICT OF COLUMBIA:		
Washington, defenses of—		
1862–65		1,250,000.00
FLORIDA:		
Fort Barrancas—		
1838–57		523,500.00
Fort Clinch—		
1846–65	700,000.00	
June 12, 1866	50,000.00	
Mar. 2, 1867	12,500.00	
		762,500.00
Fort Jefferson—		
1844–65	2,725,000.00	
June 12, 1866	50,000.00	
Mar. 2, 1867	25,000.00	
Mar. 3, 1871	42,500.00	
June 10, 1872	42,500.00	
Feb. 21, 1873	50,000.00	
		2,935,000.00
Fort Marion—		
1833–49	139,766.96	
July 5, 1884	5,000.00	
Aug. 18, 1890	15,000.00	
		159,766.96
Fort McRea—		
1833–60		447,000.00
Fort Pickens—		
1828–57	766,223.31	
Feb. 10, 1875	25,000.00	
		791,223.31

FLORIDA—Continued.		
Fort Taylor, Key West—		
1848–65	$2,160,000.00	
June 12, 1866	100,000.00	
Mar. 2, 1867	25,000.00	
June 10, 1872	42,500.00	
Feb. 21, 1873	50,000.00	
Apr. 3, 1874	20,000.00	
Feb. 10, 1875	15,000.00	
		$2,412,500.00
Total		8,081,490.27
GEORGIA:		
Fort Jackson—		
1823–57	270,000.00	
June 10, 1872	15,000.00	
		285,000.00
Fort Pulaski—		
1830–57	882,308.56	
Mar. 3, 1871	26,500.00	
June 10, 1872	25,000.00	
Feb. 21, 1873	50,000.00	
Apr. 3, 1874	20,000.00	
Feb. 10, 1875	25,000.00	
		1,028,808.56
Total		1,313,808.56
INDIAN TERRITORY:		
Fort Towson—		
1842–44		16,000.00
LOUISIANA:		
Bayou Bienvenue, battery at—		
1826–50		113,951.80
Fort Jackson—		
1822–63	895,692.00	
Mar. 3, 1871	50,000.00	
June 10, 1872	64,000.00	
Feb. 21, 1873	65,000.00	
Apr. 3, 1874	30,000.00	
Feb. 10, 1875	25,000.00	
		1,129,692.00
Fort Livingston—		
1833–57		385,000.00
Fort Macomb—		
1831–57		52,180.00
Fort Pike, the Rigolets—		
1821–54		660,192.00
Fort at Proctors Landing, Lake Borgne—		
1855–57		150,000.00
Fort St. Philip—		
1840–63	363,300.00	
Mar. 3, 1871	37,500.00	
June 10, 1872	42,500.00	
Feb. 21, 1873	50,000.00	
Apr. 3, 1874	30,000.00	
Feb. 10, 1875	25,000.00	
		548,300.00
Tower Dupre—		
1829–57		35,077.41
Total		3,074,393.21

MAINE:		
Battery on Portland Head—		
June 10, 1872	$50,000.00	
Feb. 10, 1875	20,000.00	$70,000.00
Fort Gorges—		
1857–65	730,000.00	
June 12, 1866	50,000.00	
Mar. 2, 1867	25,000.00	
Mar. 3, 1871	15,000.00	
June 10, 1872	20,000.00	840,000.00
Fort Knox—		
1841–65		930,000.00
Fort McClary—		
1840–65	214,250.00	
Mar. 2, 1867	25,000.00	239,250.00
Fort Popham—		
1857–65	375,000.00	
June 12, 1866	50,000.00	425,000.00
Fort Preble—		
1833–65	412,970.00	
Mar. 2, 1867	25,000.00	
Mar. 3, 1871	28,500.00	
June 10, 1872	42,500.00	
Feb. 21, 1873	40,000.00	
Apr. 3, 1874	20,000.00	
Feb. 10, 1875	10,000.00	578,970.00
Fort Scammel—		
1840–65	428,400.00	
June 12, 1866	35,000.00	
Mar. 2, 1867	25,000.00	
Mar. 3, 1871	50,000.00	
June 10, 1872	42,500.00	
Feb. 21, 1873	50,000.00	
Apr. 3, 1874	30,000.00	
Feb. 10, 1875	20,000.00	680,900.00
Total		3,764,120.00
MARYLAND:		
Fort Carroll—		
1846–64		1,375,000.00
Fort Foote—		
June 10, 1872	21,000.00	
Feb. 21, 1873	25,000.00	46,000.00
Fort at Lazaretto Point—		
June 10, 1872		13,000.00
Fort Madison—		
1841–57		55,600.00
Fort McHenry—		
1829–38	84,005.40	
June 10, 1872	21,000.00	
Feb. 21, 1873	25,000.00	
Feb. 10, 1875	20,000.00	150,005.40
Fort Washington—		
1821–65	238,000.00	
June 12, 1866	20,000.00	
Mar. 2, 1867	12,500.00	
June 10, 1872	21,000.00	
Feb. 21, 1873	25,000.00	316,500.00
Total		1,955,505.40

MASSACHUSETTS:		
Battery on Long Island Head, Boston Harbor—		
Mar. 28, 1867	$5,000.00	
Mar. 3, 1871	37,500.00	
Apr. 3, 1874	40,000.00	
Feb. 10, 1875	30,000.00	
		$112,500.00
Fort at Clarks Point, New Bedford Harbor—		
1857–65	650,000.00	
June 12, 1866	30,000.00	
Mar. 2, 1867	15,000.00	
		695,000.00
Fort Independence—		
1832–65	531,094.00	
Mar. 2, 1867	25,000.00	
Mar. 3, 1871	27,500.00	
July 11, 1871	53,000.00	
June 10, 1872	42,500.00	
Feb. 21, 1873	35,000.00	
		714,094.00
Fort Warren—		
1833–65	1,323,000.00	
June 12, 1866	25,000.00	
Mar. 2, 1867	25,000.00	
July 11, 1870	100,000.00	
Mar. 3, 1871	50,000.00	
June 10, 1872	85,000.00	
Feb. 21, 1873	40,000.00	
Feb. 10, 1875	25,000.00	
		1,673,000.00
Fort Winthrop—		
1841–65	385,000.72	
June 12, 1866	30,000.00	
Mar. 2, 1867	25,000.00	
July 11, 1870	69,000.00	
Mar. 3, 1871	45,500.00	
June 10, 1872	64,000.00	
Feb. 21, 1873	50,000.00	
		668,500.72
Total		3,863,094.72
MICHIGAN:		
Fort at Green Bay—		
1834		10,000.00
Fort Wayne—		
1841–65	275,000.00	
June 12, 1866	50,000.00	
		325,000.00
Total		335,000.00
MISSISSIPPI:		
Fort at Ship Island—		
1857–65	545,000.00	
June 12, 1866	10,000.00	
Total		555,000.00
NEW HAMPSHIRE:		
Battery in Portsmouth Harbor—		
1862–65	550,000.00	
Feb. 21, 1873	50,000.00	
Apr. 3, 1874	30,000.00	
Feb. 10, 1875	20,000.00	
		650,000.00
Fort Constitution—		
1826–65	336,771.00	
June 12, 1866	75,000.00	
		411,771.00
Total		1,061,771.00

NEW JERSEY:		
Battery at Finns Point—		
July 11, 1870	$33,500.00	
Mar. 3, 1871	20,000.00	
Feb. 21, 1873	40,000.00	
Apr. 3, 1874	30,000.00	
Feb. 10, 1875	25,000.00	
		$148,500.00
Fort at Sandy Hook—		
1857–65	1,050,000.00	
June 12, 1866	50,000.00	
Mar. 2, 1867	25,000.00	
Aug. 1, 1894	7,500.00	
Mar. 3, 1897	75,000.00	
		1,207,500.00
Total		1,356,000.00
NEW YORK:		
Battery Hudson—		
1850–64	385,000.00	
July 11, 1870	30,000.00	
Mar. 3, 1871	16,500.00	
June 10, 1872	17,000.00	
Feb. 21, 1873	29,000.00	
Apr. 3, 1874	13,000.00	
Feb. 10, 1875	15,000.00	
		505,500.00
Battery at Willets Point—		
1857–65	950,000.00	
June 12, 1866	50,000.00	
Mar. 2, 1867	25,000.00	
July 11, 1870	90,000.00	
Mar. 3, 1871	45,000.00	
June 10, 1872	76,500.00	
Feb. 21, 1873	40,000.00	
Apr. 3, 1874	30,000.00	
Feb. 10, 1875	25,000.00	
		1,331,500.00
Fort Columbus and Castle William—		
1831–64	416,897.00	
July 11, 1870	52,000.00	
		468,897.00
Fort Hamilton—		
1824–65	988,000.00	
June 12, 1866	30,000.00	
July 11, 1870	46,000.00	
Mar. 3, 1871	25,000.00	
June 10, 1872	40,000.00	
Feb. 21, 1873	40,000.00	
Apr. 3, 1874	26,000.00	
Feb. 10, 1875	10,000.00	
		1,205,000.00
Fort Lafayette—		
1829–57		66,113.16
Fort Montgomery—		
1841–65	750,000.00	
June 12, 1866	50,000.00	
Mar. 2, 1867	12,500.00	
		812,500.00
Fort Niagara—		
1838–65		124,500.00
Fort Ontario—		
1839–65	145,500.00	
June 12, 1866	50,000.00	
		195,500.00
Fort Porter—		
1841–65		180,000.00

NEW YORK—Continued.		
Fort Schuyler—		
1826–65	$1,052,000.00	
June 12, 1866	30,000.00	
Mar. 2, 1867	25,000.00	
July 11, 1870	80,000.00	
Mar. 3, 1871	57,500.00	
June 10, 1872	85,000.00	
Feb. 21, 1873	65,000.00	
Apr. 3, 1874	25,000.00	
Feb. 10, 1875	25,000.00	
		$1,444,500.00
Fort Tompkins—		
1857–65	942,300.00	
June 12, 1866	50,000.00	
Mar. 2, 1867	25,000.00 [1] 238,000.41	
Mar. 3, 1871	52,000.00	
June 10, 1872	83,000.00	
Feb. 21, 1873	30,000.00	
Apr. 3, 1874	30,000.00	
Feb. 10, 1875	20,000.00	
		1,470,300.41
Fort Wadsworth (formerly Fort Richmond)—		
1846–64	738,646.56	
Feb. 10, 1875	5,000.00	
		743,646.56
Fort Wood, Bedloes Island—		
1841–57	218,000.00	
July 11, 1870	16,000.00	
June 10, 1872	17,000.00	
		251,000.00
Governors Island—		
Aug. 18, 1890		50,000.00
Total		8,848,957.13
NORTH CAROLINA:		
Fort Caswell—		
1825–57	544,264.59	
May 25, 1900	150,000.00	
		694,264.59
Fort Macon, Beaufort—		
1825–61		466,500.00
Total		1,160,764.59
PENNSYLVANIA:		
Fort Mifflin—		
1841–65	75,900.00	
June 12, 1866	25,000.00	
July 11, 1870	55,000.00	
Mar. 3, 1871	26,000.00	
June 10, 1872	72,000.00	
Feb. 10, 1875	25,000.00	
Total		278,900.00
RHODE ISLAND:		
Battery on Dutch Island—		
1862–63	350,000.00	
Feb. 21, 1873	40,000.00	
Apr. 3, 1874	20,000.00	
Feb. 10, 1875	20,000.00	
		430,000.00

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[1] Transferred from Battery Hudson, above.

RHODE ISLAND—Continued.

Fort Adams, Bretons Point—		
1824–65	$1,838,316.67	
June 10, 1872	85,000.00	
Feb. 21, 1873	65,000.00	
Apr. 3, 1874	20,000.00	
Feb. 10, 1875	15,000.00	
		$2,023,316.67
Fort Wolcott—		
1827–36		1,000.00
Total		2,454,316.67

SOUTH CAROLINA:

Castle Pinckney—		
1841–56		12,000.00
Fort Johnson—		
1841–54		38,700.00
Fort Moultrie—		
1828–60	942,144.91	
Mar. 3, 1871	25,000.00	
June 10, 1872	35,000.00	
Feb. 21, 1873	40,000.00	
Apr. 3, 1874	20,000.00	
Feb. 10, 1875	15,000.00	
		1,077,144.91
Fort Sumter—		
1840–59	823,000.00	
Mar. 3, 1871	25,000.00	
June 10, 1872	35,000.00	
Feb. 21, 1873	40,000.00	
Apr. 3, 1874	20,000.00	
		943,000.00
Sullivans Island, Charleston—		
May 25, 1900		135,000.00
Total		2,205,844.91

TEXAS:

Defenses of Galveston Harbor—		
1857–60		100,000.00
Fort Brown—		
1854–55	150,000.00	
Mar. 3, 1875	25,000.00	
		175,000.00
Fort Duncan—		
1875		10,000.00
Total		285,000.00

VIRGINIA:

Fort Monroe—		
1821–65	2,224,113.10	
June 12, 1866	30,000.00	
Mar. 2, 1867	25,000.00	
June 10, 1872	42,500.00	
Feb. 21, 1873	40,000.00	
Apr. 3, 1874	30,000.00	
Feb. 10, 1875	20,000.00	
Aug. 4, 1886	100,000.00	
Aug. 10, 1888	75,000.00	
June 30, 1890	20,000.00	
Feb. 24, 1891	27,000.00	
Artesian wells	6,000.00	
Aug. 1, 1894	37,500.00	
		2,677,113.10
Fort Wool (formerly Calhoun), ripraps—		
1821–64		2,355,000.00
Total		5,032,113.10

MISCELLANEOUS:

Batteries, gun and mortar—

Aug. 18, 1890	$1,221,000.00	
Feb. 24, 1891	750,000.00	
July 23, 1892	500,000.00	
Feb. 18, 1893	50,000.00	
Aug. 1, 1894	500,000.00	
Mar. 2, 1895	500,000.00	
June 6, 1896	2,400,000.00	
Mar. 3, 1897	3,841,333.00	
Allotments from the appropriation for "national defense," act of Mar. 9, 1898	3,827,842.80	
May 7, 1898	3,000,000.00	
July 7, 1898	2,562,000.00	
Mar. 3, 1899	1,000,000.00	
May 25, 1900	2,000,000.00	
Mar. 1, 1901	1,615,000.00	
June 6, 1902	2,000,000.00	
Mar. 3, 1903	2,236,425.00	
Apr. 21, 1904	700,000.00	
May 27, 1908	300,000.00	
Mar. 3, 1909	5,064.00	
		$29,008,664.80

Batteries, gun and mortar, insular possessions—

	Generally applicable.	Hawaiian Islands.	Philippine Islands.	
Apr. 21, 1904	$700,000.00			
Mar. 3, 1905	700,000.00			
June 25, 1906		$260,000.00		
Mar. 2, 1907		200,000.00	$500,000.00	
May 27, 1908		400,000.00	954,000.00	
Mar. 3, 1909		337,200.00	1,000,000.00	
June 23, 1910			800,000.00	
Mar. 4, 1911		150,000.00	1,169,000.00	
June 6, 1912		170,000.00	800,000.00	
	1,400,000.00	1,517,200.00	5,223,000.00	
				8,140,200.00

Batteries, pneumatic—

July 7, 1898	[1] $150,000.00	
May 25, 1900	180,000.00	
		330,000.00

Board, Endicott—

Mar. 3, 1885	40,000.00

Columbia River, defenses at mouth of, Oregon and Washington Territory—

1862–64	400,000.00

Contingencies of fortifications—

1821–65	5,711,677.17	
July 11, 1870	150,000.00	
Mar. 3, 1871	250,000.00	
June 10, 1872	250,000.00	
Feb. 21, 1873	100,000.00	
Apr. 3, 1874	75,000.00	
Feb. 10, 1875	75,000.00	
Mar. 3, 1883	158.00	
July 7, 1884	93.87	
Aug. 4, 1886	2,339.42	
Sept. 30, 1890	71.17 2,682.39 [2] 74,768.48	
Mar. 3, 1891	13.90 28.00	
July 28, 1892	352.17	
Mar. 3, 1893	77.02	
July 7, 1898	2.22	
June 6, 1900	54.79	
		6,692,318.60

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[1] San Francisco Harbor.

[2] Credited in accounts of Maj. J. C. Fremont.

MISCELLANEOUS—Continued.

Emplacements, modernizing older—		
Mar. 3, 1905	$450,000.00	
June 25, 1906	150,000.00	
Mar. 2, 1907	100,000.00	
May 27, 1908 (new application of funds appropriated for pneumatic-dynamite batteries)	165,261.36	
Mar. 3, 1909	100,000.00	
		$965,261.36
Fortifications—		
1813–36		4,860,723.10
Fortifications of ports and harbors—		
1794–1812		4,551,046.30
Fortifications, plans of—		
Aug. 18, 1890	5,000.00	
Feb. 24, 1891	5,000.00	
July 23, 1892	5,000.00	
Feb. 18, 1893	5,000.00	
Aug. 1, 1894	5,000.00	
Mar. 2, 1895	5,000.00	
June 6, 1896	5,000.00	
Mar. 3, 1897	5,000.00	
May 7, 1898	5,000.00	
Mar. 3, 1899	5,000.00	
May 25, 1900	5,000.00	
		55,000.00
Fortifications on the northern frontier—		
1862		750,000.00
National defense—		
Mar. 9, 1899		[1]3,817,879.62
Plant—Electric light and power—		
May 25, 1900		25,000.00
Plant—Electrical installation—		
May 27, 1908	348.888.00	
Mar. 3, 1909	100.000.00	
Mar. 4, 1911	50,000.00	
		498,888.00
Plant—Searchlights and electrical connections—		
Mar. 1, 1901 (New York Harbor)	150.000.00	
June 6, 1902	150,000.00	
Mar. 3, 1903	150,000.00	
Apr. 21, 1904	150,000.00	
Mar. 3, 1905	200,000.00	
June 25, 1906	125,000.00	
Mar. 2, 1907	210,000.00	
May 27, 1908	210.000.00	
Mar. 3, 1909	210,000.00	
June 23, 1910	50,000.00	
Mar. 4, 1911	50.000.00	
June 6, 1912 (reappropriated from balances of other funds)	25,000.00	
		1,680,000.00
Plant—Reserve lights—		
Mar. 3, 1909		10,000.00

Plant—Searchlights, insular possessions—

	Generally applicable.	Hawaiian Islands.	Philippine Islands.	
Mar. 2, 1907	$30.000.00			
May 27, 1908		$47,500.00	$180,000.00	
Mar. 3, 1909		66,000.00		
June 23, 1910			139,000.00	
Mar. 4, 1911		40,100.00		
Total	30,000.00	153,600.00	319,000.00	
				502,600.00

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[1] Allotted from $50,000,000 for national defense.

MISCELLANEOUS—Continued.

Plant—Electrical installations, insular possessions—

	Hawaiian Islands.	Philippine Islands.	
May 27, 1908	$20,000.00	$115,000.00	
Mar. 3, 1909	14,469.00	88,823.00	
June 23, 1910		45,000.00	
Mar. 4, 1911		171,962.00	
Total	34,469.00	420,785.00	
			$455,254.00

Preservation and repair of fortifications—

1841–61	67,000.00	
June 8, 1868	200,000.00	
Mar. 3, 1869	200,000.00	
July 11, 1870	75,000.00	
June 20, 1876	100,000.00	
Mar. 3, 1877	100,000.00	
Mar. 3, 1878	100,000.00	
Mar. 3, 1879	100,000.00	
May 4, 1880	100,000.00	
Mar. 3, 1881	175,000.00	
May 19, 1882	175,000.00	
Mar. 3, 1883	175,000.00	
July 5, 1884	175,000.00	
Mar. 3, 1885	100,210.00	
Sept. 22, 1888	100,000.00	
Mar. 2, 1889	100,000.00	
Aug. 18, 1890	80,000.00	
Feb. 24, 1891	80,000.00	
July 23, 1892	60,000.00	
Feb. 18, 1893	45,000.00	
Aug. 1, 1894	45,000.00	
Mar. 2, 1895	45,000.00	
June 6, 1896	50,000.00	
Mar. 2, 1897	100,000.00	
May 7, 1898	100,000.00	
Mar. 3, 1899	100,000.00	
May 25, 1900	100,000.00	
Mar. 1, 1901	100,000.00	
Feb. 14, 1902	3,000.00	
June 6, 1902	300,000.00	
Mar. 3, 1903	300,000.00	
Apr. 21, 1904	300,000.00	
Mar. 3, 1905	300,000.00	
June 25, 1906	200,000.00	
Mar. 2, 1907	200,000.00	
May 27, 1908	225,000.00	
Mar. 3, 1909	225,000.00	
June 23, 1910	300,000.00	
Mar. 4, 1911	300,000.00	
June 6, 1912 ($125,000 reappropriated from balances of other funds)	300,000.00	
		4,058,000.00

Preservation and repair of fortifications, insular possessions—

	Hawaiian Islands.	Philippine Islands.	
June 23, 1910		$7,000.00	
Mar. 4, 1911		7,000.00	
June 6, 1912	$500.00	8,000.00	
	500.00	22,000.00	
			22,500.00

MISCELLANEOUS—Continued.

Preservation and repair, torpedo structures—

June 25, 1906	$10,000.00	
Mar. 2, 1907	10,000.00	
May 27, 1908	15,000.00	
Mar. 3, 1909	20,000.00	
June 23, 1910	20,000.00	
Mar. 4, 1911	20,000.00	
June 6, 1912	20,000.00	
		$115,000.00

Preservation and repair, torpedo structures, insular possessions—

June 23, 1910 (Philippine Islands)	1,000.00	
Mar. 4, 1911 (Philippine Islands)	1,000.00	
June 6, 1912 (Philippine Islands)	500.00	
		2,500.00

Range and position finders—

Prior to 1905 appropriations for this work were made under the title "Installation of range and position finders" (expended entirely by the Engineer Department), as follows:

July 7, 1898	150,000.00	
May 25, 1900	150,000.00	
Mar. 1, 1901	150,000.00	
June 6, 1902	325,000.00	
Mar. 3, 1903	223,500.00	
Apr. 21, 1904	225,000.00	
		1,223,500.00

Later appropriations have been made, under the title "Fire control at fortifications," applicable to the work of the Engineer and Ordnance Departments and the Signal Corps. The amounts appropriated and the portions thereof assigned to the Engineer Department are as follows:

	Appropriated.	Assigned to Engineer Department.	
Mar. 3, 1905	$1,000,000.00	$590,000.00	
June 25, 1906	700,000.00	217,631.37	
Mar. 2, 1907	900,000.00	432,784.81	
May 27, 1908	270,256.00	129,456.00	
Mar. 3, 1909	247,055.00	211,555.00	
June 23, 1910	200,000.00	98,690.39	
Mar. 4, 1911	100,000.00		
June 6, 1912	100,000.00		
	3,517,311.00	1,680,117.57	
			3,517,311.00

Fire control at batteries, insular possessions—

	Appropriated.	Assigned to Engineer Department.	
Mar. 2, 1907	$100,000.00	$75,000.00	
May 27, 1908	243,000.00	75,000.00	
Mar. 3, 1909	250,000.00	222,427.00	
June 23, 1910	200,000.00	13,150.00	
	793,000.00	385,577.00	
			793,000.00

Seacoast mortar batteries—

July 11, 1870	75,000.00	
Mar. 3, 1871	100,000.00	
June 2, 1872	100,000.00	
June 14, 1878	301.50	
		275,301.50

MISCELLANEOUS—Continued.

Sea walls and embankments—

Sept. 22, 1888	$117,000.00	
June 6, 1896	17,975.00	
Mar. 3, 1897	33,000.00	
May 7, 1898	55,000.00	
Mar. 3, 1899	2,500.00	
May 25, 1900	50,000.00	
Mar. 1, 1901	100,000.00	
June 6, 1902	100,000.00	
Mar. 3, 1903	89,575.00	
Apr. 21, 1904	99,000.00	
Mar. 3, 1905	19,400.00	
June 25, 1906	50,000.00	
Mar. 2, 1907	25,000.00	
May 27, 1908	50,000.00	
Mar. 3, 1909	50,000.00	
June 6, 1912 (reappropriated from balances of other funds)	25,000.00	
		$883,450.00

Sites for seacoast defenses—

June 12, 1866	35,000.00	
Mar. 2, 1867	37,500.00	
Mar. 3, 1871	150,000.00	
Aug. 18, 1890	500,000.00	
Feb. 24, 1891	500,000.00	
July 23, 1892	500,000.00	
Feb. 18, 1893	175,000.00	
Aug. 1, 1894	150,000.00	
June 6, 1896	500,000.00	
Mar. 3, 1897	300,000.00	
May 7, 1898	300,000.00	
Mar. 3, 1899	300,000.00	
May 25, 1900	200,000.00	
Mar. 1, 1901	200,000.00	
June 6, 1902	200,000.00	
Mar. 3, 1903	200,000.00	
Apr. 21, 1904	100,000.00	
May 27, 1908	121,048.00	
Mar. 3, 1909	250,000.00	
		4,718,448.00

Sites, insular possessions—

	Hawaiian Islands.	Philippine Islands.	
Apr. 21, 1904	$200,000.00	....	
June 25, 1906	150,000.00	....	
May 27, 1908	....	$5,000.00	
Mar. 3, 1909	....	12,000.00	
	350,000.00	17,000.00	
			367,000.00

Supplies for seacoast defenses—

May 25, 1900	25,000.00	
Mar. 1, 1901	25,000.00	
June 6, 1902	25,000.00	
Mar. 3, 1903	35,000.00	
Apr. 21, 1904	35,000.00	
Mar. 3, 1905	40,000.00	
June 25, 1906	30,000.00	
Mar. 2, 1907	40,000.00	
May 27, 1908	44,500.00	
Mar. 3, 1909	40,000.00	
June 23, 1910	45,000.00	
Mar. 4, 1911	45,000.00	
June 6, 1912	45,000.00	
		474,500.00

MISCELLANEOUS—Continued.

Supplies for seacoast defenses, insular possessions—

	Hawaiian Islands.	Philippine Islands.	
June 23, 1910	....	$2,500.00	
Mar. 4, 1911	$1,000.00	2,500.00	
June 6, 1912	750.00	2,500.00	
	1,750.00	7,500.00	
			$9,250.00

Equipment of Coast Artillery, armories, Organized Militia—

Mar. 3, 1911	238,170.00

Actual amount assigned to Engineer Department, $105,426.56.

Submarine mines—

	Appropriated.	Covered into surplus fund or repaid to national-defense fund.	Net appropriation.
May 19, 1882—			
Torpedoes, preservation of torpedoes, experiments, and instruction of troops	$100,000.00	....	$100,000.00
Mar. 3, 1883—			
One-half for latest improved torpedoes	75,000.00	....	75,000.00
July 5, 1884—			
Purchase, if recommended, of submarine movable torpedoes	50,000.00	....	50,000.00
Improving and testing motors for movable torpedoes	25,000.00	....	25,000.00
Submarine mines	5,000.00	....	5,000.00
Torpedo experiments and instruction of troops	20,000.00	....	20,000.00
Mar. 3, 1885—			
Submarine movable torpedoes	50,000.00	....	50,000.00
Motors for torpedoes	25,000.00	....	25,000.00
Appliances for submarine mines	19,000.00	....	19,000.00
Experiments and instructions	20,000.00	....	20,000.00
Sept. 22, 1888—			
Materials, structures, experiments, instruction, and movable torpedoes	200,000.00	....	200,000.00
Mar. 2, 1889—			
Mines and appliances	250,000.00	....	250,000.00
Structures	250,000.00	....	250,000.00
Experiments and instruction	30,000.00	....	30,000.00
Movable torpedoes	50,000.00	$24,775.00	25,225.00
Shed, San Francisco	22,000.00	216.77	21,783.23
Aug. 18, 1890—			
Mines and appliances	100,000.00	....	100,000.00
Structures	100,000.00	....	100,000.00
Experiments and instruction	30,000.00	100.09	29,900.00
Feb. 24, 1891—			
Mines and appliances	50,000.00	....	50,000.00
Structures	50,000.00	....	50,000.00
Structures, Goat Island, Cal	16,000.00	4,616.68	11,383.32
Mar. 2, 1895—			
Mines and appliances	20,000.00	....	20,000.00
Structures	20,000.00	....	20,000.00
June 6, 1896—			
Materials and structures	100,000.00	....	100,000.00
Mar. 3, 1897—			
Materials and structures	150,000.00	....	150,000.00

MISCELLANEOUS—Continued.

Submarine mines—Continued.

	Appropriated.	Covered into surplus fund or repaid to national-defense fund.	Net appropriation.
Mar. 9, 1898 (national defense); presidential allotments—			
Mar. 17, 1898—Materials, including searchlights	$250,000.00	....	$250,000.00
Mar. 31, 1898—Portion of allotment for torpedo service	8,725.00	....	8,725.00
Apr. 2, 1898—Torpedo operations	1,150,000.00	$120,323.70	1,029,676.30
Apr. 21, 1898—Planting torpedoes	150,000.00	48,290.45	101,709.55
Jan. 21, 1899—Torpedo defense (actually expended from consolidated allotment)	456.71	....	456.71
May 4, 1898—			
Material	50,000.00	1,194.39	48,805.61
Planting mines	300,000.00	68,097.84	231,902.16
May 7, 1898—			
Materials and structures	150,000.00	....	150,000.00
July 7, 1898—			
Maintenance of mine fields	736,000.00	736,000.00	....
Additional material, operating searchlights and electric plants	650,000.00	192,616.49	457,383.51
Mar. 3, 1899—			
Material and structures	50,000.00	....	50,000.00
May 25, 1900—			
Material and structures	50,000.00	....	50,000.00
Mar. 1, 1901—			
Material and structures	50,000.00	....	50,000.00
Feb. 14, 1902—			
Deficiency	2.68	....	2.68
June 6, 1902—			
Structures	33,000.00	....	33,000.00
July 1, 1902—			
Deficiency	4.38	....	4.38
Mar. 3, 1903—			
Structures	50,000.00	....	50,000.00
Apr. 21, 1904—			
Structures	87,000.00	....	87,000.00
Mar. 3, 1905—			
Structures	400,000.00	....	400,000.00
June 25, 1906—			
Structures	175,000.00	....	175,000.00
Mar. 2, 1907—			
Structures	175,000.00	....	175,000.00
May 27, 1908—			
Structures	175,000.00	....	175,000.00
Mar. 3, 1909—			
Structures	100,000.00	....	100,000.00
Mar. 4, 1911—			
Structures	50,000.00	....	50,000.00
	6,667,188.77	1,196,231.32	5,470,957.45

Submarine mines, insular possessions—

	Generally applicable.	Philippine Islands.	Hawaiian Islands.	
June 8, 1898 (for Manila Harbor)	....	$150,000.00	....	
Mar. 2, 1907	$200,000.00	....	....	
May 27, 1908	....	....	$129,000.00	
				$479,000.00

Total, miscellaneous	85,530,823.73
Grand total	142,997,918.85

Part 2, FMA. Recapitulation of Appropriations for Fortifications, by States.

Alabama	$1,796,198.87
Arkansas	152,707.71
California	5,830,000.00
Connecticut	360,400.00
Delaware	2,485,708.98
District of Columbia	1,250,000.00
Florida	8,031,490.27
Georgia	1,313,808.56
Indian Territory	16,000.00
Louisiana	3,074,393.21
Maine	3,764,120.00
Maryland	1,955,505.40
Massachusetts	3,863,094.72
Michigan	335,000.00
Mississippi	555,000.00
New Hampshire	1,061,771.00
New Jersey	1,356,000.00
New York	8,848,957.13
North Carolina	1,160,764.59
Pennsylvania	278,900.00
Rhode Island	2,454,316.67
South Carolina	2,205,844.91
Texas	285,000.00
Virginia	5,032,113.10
MISCELLANEOUS[1]	85,530,823.73
Total	142,997,918.85

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[1] Lump appropriations, disbursed among various works throughout the U. S., etc.

FMB. BOARDS.

Part.	Title.
1	The Board of Engineers.
2	Board of Engineers on the Pacific coast.
3	Board on torpedo system.
4	Endicott Board.
5	Roosevelt ("Taft Board") Board.

Part 1, FMB. Boards of Engineers on Fortifications.

ENGINEERS.

Chief of Engineers. R., 66, 11, 2; 67, 2; 70, 28; 71, 26; 72, 24; 73, 25; 74, 29; 75, 28; 76, 30; 77, 24; 78, 28; 79, 33; 80, 54; 81, 56; 82, 56, 411; 83, 51; 84, 55; 85, 48; 86, 48; 87, 5; 88, 5; 89, 8; 90, 6; 91, 11; 92, 16; 93, 15; 94, 15; 95, 15: 96, 5, 447; 97, 4, 553; 98, 5, 557; 99, 5, 645; 00, 5, 727; 01, 5, 691; 02, 6, 615; 03, 8, 679; 04, 4, 749; 05, 4, 755; 06, 4, 835; 07, 5, 865; 08, 9, 907; 09, 10, 955; 10, 11; 11, 7; 12, 6.

Officers:[1]

Col. G. J. Barnard, 1867–80.
Col. G. W. Cullum, 1867–74.
Col. Z. B. Tower, 1867–83.
Lt. Col. H. G. Wright, 1867–79.
Maj. C. B. Reese, 1867.
Capt. C. W. Raymond, 1870.
Col. J. Newton, 1880–84.
Col. H. L. Abbot, 1880–95.
Col. C. B. Comstock, 1883–94.
Col. J. C. Duane, 1884–87.
Col. D. C. Houston, 1886–93.
Lt. Col. W. McFarland, 1886–88.
Col. T. L. Casey, 1887–89.
Col. W. P. Craighill, 1887–89.
Maj. W. R. King, 1887–89.
Col. G. L. Gillespie, 1889–1900.
Col. H. M. Robert, 1893–1900. R., 96. 447; 97, 553; 98, 557; 99. 645; 00, 727.
Maj. C. W. Raymond, 1895–96.
Maj. J. G. D. Knight, 1896–97.
Capt. H. F. Hodges, 1896–98.
Maj. H. M. Adams, 1897–99.
Col. J. W. Barlow, 1899–1900.
Capt. W. V. Judson, 1899.
Capt. E. Jadwin, 1900–01.
Col. C. R. Suter, 1900–06.
Col. S. M. Mansfield, 1900.
Lt. Col. C. W. Raymond, 1900–04.
Maj. S. Pratt (Coast Artillery), 1900.
Lt. E. H. Schulz, 1901–02.
Col. A. Stickney, 1902–07.
Lt. Col. W. R. Livermore, 1902–05.
Commander W. J. Barnette (U. S. N.), 1902.
Maj. R. Birnie (Ord. Dept.), 1902–07 (Lt. Col.).
Maj. A. Murray (Artillery Corps), 1905 (Lt. Col.)
Capt. R. Wainwright (U. S. N.), 1904–10 (Rear Admiral).
Col. D. W. Lockwood, 1906–09.
Col. J. G. D. Knight, 1906–09.
Maj. J. E. Kuhn, 1906–08.
Col. W. L. Marshall, 1907.
Lt. Col. E. B. Babbitt (Ord. Dept.), 1907–10.
Col. S. W. Roessler, 1908–10.
Capt. H. L. Wigmore, 1908–10.
Col. Wm. T. Rossell, 1909.
Col. W. M. Black, 1909.
Capt. E. M. Adams, 1910.

Part 2, FMB. Board of Engineers on the Pacific Coast.

ENGINEERS.

Chief of Engineers. R., 67, 2; 68, 4; 70, 28; 71, 26; 72, 25; 73, 26; 74, 32; 75, 32; 76, 32; 77, 28; 78, 31; 79, 39; 80, 60; 81, 60; 82, 60; 83, 56 84, 64; 85, 52.

Officers:[2]

Lt. Col. B. S. Alexander, 1867–79.
Capt. C. W. Raymond, 1867–69.
Capt. T. H. Handbury, 1870–73.
Lt. Col. G. H. Mendell, 1872–85.
Lt. Col. C. S. Stewart, 1873–85.
Lt. J. H. Weeden, 1873–77.
Lt. Col. R. S. Williamson, 1876–82.
Capt. A. H. Payson, 1877–83.
Maj. J. M. Wilson, 1878.
Maj. G. L. Gillespie, 1879–80.

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[1] And for the time being the officers of the defenses under consideration, 73, 25.

Col. G. H. Mendell was a member when matter pertaining to the defensive works on the Pacific coast was acted upon, 90, 6.

[2] And for the time being the officers of the defenses under consideration.

List of subjects referred by the Chief of Engineers, and the special duties of the individual members, given in each annual report beginning with 1879.

Part 3, FMB. Board on Torpedo System.

Chief of Engineers. **R., 99**, 5; **00**, 5; **01**, 5; **02**, 6.

Officers:

Capt. J. Millis, 1898–99.
Lt. J. F. McIndoe, 1899.
Lt. G. P. Howell, 1899–1900.
Maj. J. G. D. Knight, 1898–1900. **R., 99, 640; 00, 731.**
Capt. H. Jervey, 00.
Maj. H. M. Black, 1900–01.
Capt. J. F. McIndoe, 1900–01.
Capt. G. P. Howell, 1900–01.

Part 4, FMB. Endicott Board.[1]

BOARD OF ENGINEERS.

(Endicott Board.) Constituted by act of Mar. 3, 1885, to examine and report at what ports, fortifications, or other defenses mostly required, the character and kind of defenses best adapted for each, with reference to armament and the utilization of torpedoes, mines, or other defensive appliances. **R., 86**, 499. (W. C. Endicott, Sec. of War, presi-

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[1] This board might be considered the result of repeated invitations of the Chief of Engineers to the alarming lack of adequate fortifications in the United States. The following extracts serve as an index to the Reports of the Chief of Engineers upon the subject:

Annual report for 1880, pp. 4, 5, 6, 8, 9, 10, 11, 12, 14, 15. Report of the Chief of Engineers, United States Army, Washington, D. C., Oct. 16, 1880.

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SEACOAST AND LAKE-FRONTIER DEFENSES.

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The importance of early and reasonable expenditures for our seacoast defenses can not be more strongly urged than by reiterating what has been stated in former reports by this department, and therefore in the following remarks on the subject the arguments and the statements contained in these reports will, when necessary, be freely used.

The United States, separated from the rest of the world by wide oceans, pursuing toward all nations a policy strikingly characterized by its pacific tendency, its impartiality and justice, contracting no political alliances, confining her intercourse with the rest of the world rigidly to the letter of such temporary arrangements as are dictated by reciprocal commercial interests, might, at first view, be regarded as too remote physically and as politically too insulated to be endangered by the convulsions which from time to time disturb the nations of the earth.

Neither our geographical position, however, nor our forbearance, nor the equity of our policy can always avail us under the relation in which it is our destiny to stand to the rest of the world.

Experience has shown that even the intercourse of traffic, much as it conduces to our prosperity, can be indulged only at the risk of obliging the Nation occasionally to assume a belligerent attitude and of surrendering to the spirit of contention—which seems to govern nations as it does the natural man—a portion of its fruits. The certainty of the return of periods of embarrassment and strife with foreign nations similar in their origin to those which have visited this Nation affords a sufficient reason of itself for securing ourselves in the best manner against the more serious evils of these unavoidable collisions.

No one acquainted with our history can hesitate to ascribe much of the wantonness and duration of the wrongs we have endured to a knowledge on the part of the nations of the scantiness and inefficiency of our military and naval forces. It is certain that in our present condition injuries to our citizens abroad and insults to our flag could not be resented with that vigor and promptitude demanded by the dignity and honor of the Nation, and justified by a knowledge that our fine harbors, important navy yards, rich commercial cities, and depots for military and naval stores were guarded by impregnable fortifications and obstructions.

It concerns the honor of the United States, when involved in controversy with other powers, to be able to appeal to the sword, but that appeal should be accompanied by the consciousness that the weapon appealed to would not be inferior to that held by the adversary. This relation of inferiority may at present exist though the adversary be a comparatively weaker power.

* * * There is nothing so costly to a nation as a lack of preparation for war. In fact, to be prepared for war will often prevent it, and though we may not feel the daily imminence of war with great foreign powers, as England did, yet with incomplete or inadequately armed defenses for our great seaport cities, even the attitude of belligerency, which we not unfrequently have to assume, has not the imposing effect it should have, nor is it accompanied with a justly founded self-confidence on our own part. The neglect of suitable preparation cost France many millions of treasure, a portion of her territory, and a great humiliation. The same must inevitably happen to the United States if it does not push forward its coast defenses and provide them with guns like those possessed not only by the great powers, but even by smaller nations.

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In the event of war with a maritime nation, if we had no well-digested system of fortifications ready for use, the cruisers and war vessels of the enemy could run into our harbors and, without landing, could dent; Brig. Gen. S. V. Benet, Chief of Ordnance; Brig. Gen. J. Newton, Chief of Engineers; Lt. Col. H. L. Abbot, Corps of Engineers; Capt. C. S. Smith, Ordnance Department; Commanders W. T. Sampson and C. F. Goodrich, U. S. Navy, and J. E. Morgan, jr., of Pennsylvania, and E. Corning, of New York.)

Report dated Jan. 16, 1886: Contents—Where defenses are most urgent. Ports arranged in order of urgency. The defenses and their accessories. List of ports, etc. Guns on hand.

Est. for land defenses, exclusive of armament, $55,483,000.

Est. for armament and mountings, $37,965,000.

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either destroy the property along our shores or else lay our cities under contribution. We have a seacoast line of more than 3,000 miles in extent on the Atlantic and Gulf of Mexico and 1,000 miles on the Pacific, not including Alaska, along both of which lie scattered all the great cities, all the depots of commerce, all the establishments of naval construction, outfit and repair, and towns, villages, and establishments of private enterprise without number. From these lines of seacoasts, navigable bays, estuaries, and rivers, the shores of which are similarly occupied, penetrate deep into the heart of the country. The accurate detailed charts of our harbors and channels published by the United States Coast Survey are accessible to all nations and are doubtless in their possession. There are foreign military and naval depots and arsenals in close proximity to our shores, and the arrival of armed vessels will follow in a few days or even hours the declaration of war.

* * * * * * *

In what way may a powerful enemy wage war against us? He may do so—

1. By attacking our commerce and navigation upon the ocean. As, however, no military preparations on the shore can avert this danger, and the means of meeting it must be purely naval, these means do not now fall under consideration; or,

2. By assailing one or more of the important points of the coast with a large military and naval force, with a view to immediate damage, or more or less protracted occupation; or,

3. By suddenly appearing with a large squadron of vessels before our principal commercial cities, laying them under contribution, and burning or carrying off the shipping, and by making powerful attacks upon our navy yards in order to destroy those establishments; or,

4. By attacks on smaller towns and establishments of the coast with small squadrons or single vessels, or with privateers, capturing or destroying the shipping therein, and levying contributions, and by like means intercepting the interior commerce within the bays, sounds, and estuaries of the coast, these lesser enterprises being often conducted under the countenance and support of considerable fleets.

The danger may take any of these forms, or all of them. And against any or all of these a naval force of equal or greater strength, if it could with any certainty be found at hand, might be an adequate resort, though it would not be the most economical. But, in the first place, we are yet, and shall be for years, inferior in our naval preparation to nations with which we are likely to be in conflict: and, next, if we were even far superior, it would be impossible to have at each of the points to be guarded a naval force sufficient to secure it, because a hostile squadron of powerful, fast-running armored steamers would fall with equal ease on either of the important points, and could with no more certainty be expected at one than at another; so that, to resist successfully, we must be ready at each and all with a force not less than that of the enemy; if less, an unavailing resistance would but augment the calamitous consequences.

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It is truly an axiom in military science, and one fully illustrated by military history, that the worst mode of waging war, although strictly defensive, is to allow its field of action to be within the borders, and that the best is that which most frequently assumes an offensive attitude. In our case war can only be excluded from our territory by fortifications, and we can only assume the offensive through our Navy. The construction of the former secures the means of creating, equipping, and repairing the latter, and leaves it unencumbered with duties which it imperfectly performs, to the full exercise of its important and appropriate functions.

The opinion that the Navy is the true defense of the country has been so acceptable and popular that it demands a careful examination.

For the purpose of first considering this proposition in its simplest terms, we will begin by supposing the Nation to possess but a single seaport, and that this is to be defended by a fleet alone.

By remaining constantly within this port our fleet would be certain of meeting the enemy should he assail it. But if inferior to the enemy there would be no reason to look for a successful defense; and as there could be no escape for the defeated vessels, the presence of the fleet instead of averting the issue would only render it the more calamitous.

Should our fleet be equal to the enemy's, the defense might be complete, and probably it would be so. Still, hazard—some of the many mishaps liable to attend contests of this nature—might decide against us, and in that event the consequences would be even more disastrous than on the preceding supposition. In this case the chances of victory to the two parties would be equal, but the consequences very unequal. It might be the enemy's fate to lose his whole fleet, but he could lose nothing more, while we, in a similar attempt, would lose not only the whole fleet, but also the object that the fleet was designed to protect.

If superior to the enemy, the defense of the port would in all respects be complete. But instead of making an attack the enemy would in such case employ himself in cutting up our commerce on the ocean, Est. for floating batteries, including armament, $18,875,000.

Est. for submarine mines and their adjuncts, $4,334,000.

Est. for torpedo boats, $9,720,000.

Grand total estimate, $126,377,800.

Appropriations recommended for first year, $21,500,000.

Annual appropriations thereafter, $9,000,000.

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and nothing could be done to protect this commerce without leaving the port in a condition to be successfully assailed.

In either of the above cases the fleet might await the enemy in front of the harbor instead of lying within. But no advantage is apparent from such an arrangement, and there would be superadded the risk of being injured by tempests, and thereby disqualified for the duty of defense, or of being driven off the coast by gales of wind, thus for a time removing all opposition.

In the same cases, also, especially when equal or superior to the enemy, our fleet, depending on having correct and timely notice as to the position and state of preparation of the enemy's forces, might think proper to meet him at the outlet of his own port, or intercept him on the way, instead of awaiting him within or off our own harbor. Here it must be noticed that the enemy, like ourselves, is supposed to possess a single harbor only, but having protected it by other means, that his navy is disposable for offensive operations. If it were attempted thus to shut him up within his own port, he, in any case but that of decided inferiority, would not hesitate to come out and risk a battle; because, if defeated, he could retire under shelter of his defenses to refit, and if successful he could proceed with a small portion of his force—even a single vessel would suffice—to the capture of our port, now defenseless, while with the remainder he would follow up his advantage over our defeated vessels, not failing to pursue them into their harbor should they return thither.

Actual superiority on our part would keep the enemy from volunteering a battle, but it would be indispensable that the superiority be steadily maintained and that the superior fleet be constantly present. If driven off by tempests or absent from any other cause, the blockaded fleet would escape, when it would be necessary for our fleet to fly back to the defense of its own port. Experience abundantly proves, moreover, that it is in vain to attempt to shut a hostile squadron in port for any length of time. It seems, then, that whether we defend by remaining at home or by shutting the enemy's fleet within his own harbor, actual superiority in vessels is indispensable to the security of our port.

With this superiority the defense will be complete, provided our fleet remain within its harbor. But then all the commerce of the country upon the ocean must be left to its fate, and no attempt can be made to react offensively upon the foe, unless we can control the chances of finding the enemy's fleet within his port, and the still more uncertain chance of keeping him there, the escape of a single vessel being sufficient to cause the loss of our harbor.

Let us next see what will be the state of the question on the supposition of numerous important ports on either side instead of a single one, relying on our part still exclusively on a navy.

In order to examine this question we will suppose our adversary to be fortified in all his harbors and possessed of available naval means equal to our own. This is certainly a fair supposition, because what is assumed as regards his harbors is true of all maritime nations except the United States, and as regards naval means it is elevating our own strength considerably above its present measure and above that it is likely to attain for years.

Being thus relatively situated, the first difference that strikes us is that the enemy, believing all his ports to be safe, without the presence of his vessels, sets at once about making our seas and shores the theater of operations, while we are left without choice in the matter; for if he think proper to come, and we are not present, he attains his object without resistance.

The next difference is, that while the enemy is certain to fall upon the single point, or the many points he may have selected, there will exist no previous indications of his particular choice, and consequently no reason for preparing our defense on one point rather than another; so that the chances of not being present and ready on his arrival are directly in proportion to the number of our ports; that is to say, the greater the number of ports, the greater the chances that he will meet no opposition whatever.

Another difference is, that the enemy can choose the mode of warfare as well as the plan of operations, leaving as little option to us in the one case as in the other. It will be necessary for us to act in the first instance on the supposition that an assault will be made with his entire fleet; because, should we act otherwise, his coming in that array would involve both fleet and coast in inevitable defeat and ruin. Being in this state of concenetration, then, should the enemy have any apprehensions as to the result of a general engagement; should he be unwilling to put anything at hazard, or should he, for any other reason, prefer acting by detachments, he can, on approaching the coast, disperse his force into small squadrons and single ships, and make simultaneous attacks on numerous points. These enterprises would be speedily consummated, because as the single point occupied by our fleet would be avoided, all the detachments would be unopposed, and after a few hours devoted to burning cities, or shipping, or public establishments and taking in spoil, the several expeditions would leave the coast for some convenient rendezvous, whence they might return, either in fleet or in detachments, to visit other portions with the scourge.

Is it insisted that our fleet might, notwithstanding, be so arranged as to meet these enterprises?

As it can not be denied that the enemy may select his point of attack out of the whole extent of coast, where is the prescience that can indicate the spot? And if it can not be foretold, how is that ubiquity to be imparted that shall always place our fleet in the path of the advancing foe. Suppose we attempt to cover

Part 5, FMB. National Coast-Defense Board (Roosevelt Board, or "Taft Board").

Appointed by President Roosevelt, Executive order, Jan. 31, 1905. * * * "a joint board of officers of the Army and Navy 'to recommend the armament, fixed and floating, mobile torpedoes, submarine mines, and all other defensive appliances that may be necessary to complete the harbor defense with the most economical and advantageous expenditure of money." * * * The board was

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the coast by cruising in front of it, shall we sweep its whole length, a distance scarcely less than that which the enemy must traverse in passing from his coast to ours? Must the Gulf of Mexico be swept, as well as the Atlantic or, shall we give up the Gulf to the enemy? Shall we cover the southern cities, or give them up also?

The uncertainty of the point on which an enemy may direct his attack, the suddenness with which he may reach it, and the powerful masses which he can concentrate at a distance out of our reach and knowledge, or suddenly, and at the very moment of attack, require that every important point be duly prepared to repel his attempt, or retard it, until reenforcements can arrive and adequate means of resistance be organized. By land we are acquainted with the motions of an enemy, with the movements and direction of its columns; we know the roads by which he must pass; but the ocean is a vast plain without obstacle there his movements are made out of our sight, and we know nothing of his approach until he is already; within the range of the eye. We must, unquestionably, do one of two things—either relinquish a great extent of coast, confining our cruisers to a small portion only, or include so much that the chances of intercepting an enemy would soon be out of the question.

But what are the enemy's means? They consist of his whole seagoing force which he concentrates for the sake of inflicting the blow.

"From the nature of maritime operations, such a fleet could bring its whole strength to bear upon any particular position, and by threatening or assailing various portions of the coast, either anticipate the tardy movements of troops upon land and effect the object before their concentration, or render it necessary to keep in service a force far superior to that of the enemy, but so divided as to be inferior to it on any one point." [Secretary of War Cass.]

On the impracticability of covering even a small extent of coast by cruising in front of it, or in other words, the impossibility of anticipating an enemy's operations; of discovering the object of movements of which we get no glimpse and hear no tidings; and of seeing the impress of his footsteps on the surface of the ocean, it would be well to consult experience.

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Our fortifications and torpedoes, then, must close all of our important harbors against an enemy, and secure them to our military and commercial marine; second, must deprive an enemy of all strong positions where, protected by naval superiority, he might fix permanent quarters in our territory, maintain himself during the war, and keep the whole frontier in perpetual alarm; third, must cover the great cities from attack; fourth, must prevent, as far as practicable, the great avenues of interior navigation from being blockaded at their entrances into the ocean; fifth, must cover the coastwise and interior navigation; and sixth, must protect the great naval establishments. In these places are to be found objects that are in every sense of the highest value. On the one hand we see accumulations of military and naval material, and structure for naval accommodation that could not be replaced during a war, which are of indispensable necessity and of great cost; and on the other hand, the untold wealth of great cities. As these objects must be great in the eyes of the enemy—great for him to gain and for us to lose—corresponding efforts on his part must be looked for and guarded against.

There should now be stated, in a few words, our system of seacoast defense, a system steadily pursued from the first by this department, but modified from time to time as new improvements in attack and defense of coasts have been introduced.

Fortifications must command from the shores exterior to our harbors all the waters from which the enemy can reach our cities and navy yards with his shot and shell; the harbor mouths and all the narrow passes within them, must also be occupied, and if nature has not afforded all the positions deemed requisite, others must, if practicable, be formed artificially. Fortifications should succeed each other along the channels of approach and in our harbors, so that the enemy may nowhere find shelter from our fire while lying within our harbors, should he succeed in passing the outer lines of works. The harbor mouths and channels must be obstructed by lines of electrical torpedoes for holding the enemy's vessels under fire of the fortifications, previously constructed and stored in the latter, and laid, on the advent of war, in systems, the plans of which have been carefully elaborated in time of peace, by studies of the local charts and tidal currents, each harbor having its own system recorded in this department. The wires, for conducting the current from the electric apparatus on shore, must at the same time be laid securely in subterranean galleries carried out to deep water, and the electric machines themselves—the hearts of the torpedo system—must be placed in chambers within the fortifications, hidden from the enemy, and secured beyond all peradventure from his direct and curved fire. These galleries and chambers must be covered with heavy masonry arches and great masses of earth, and the former, to be efficient, must be indurated, and the latter compacted by time. The torpedo lines must be served by officers selected from the Engineers and the Artillery, assisted by detachments from a torpedo corps of intelligent and skilled Engineer soldiers, and both officers and men must be thoroughly instructed in the theory and practice of electricity and torpedo obstructions, for they must know how to render the torpedoes instantly harmless for our own vessels, or active against an enemy's.

further instructed "to extend its examinations so as to include estimates and recommendations relative to defenses of the insular possessions" and to "recommend the order in which the proposed defense shall be completed, so that all the elements of harbor defense may be properly and effectively coordinated."

Report dated Feb. 1, 1906. Printed as Senate Document 248, 59th Congress, first session.

CONCLUSIONS OF THE BOARD:

The board, after carefully weighing the relative commercial and strategic importance of the ports and harbors of the United States and the insular possessions, modifies and revises the list of ports submitted by the Endicott Board as requiring defense. The revised list below is arranged in geographical order.

Heavy mortars must be placed in large numbers to command all those positions where an enemy is likely to anchor within their range, either for the purpose of tampering with, or destroying our torpedo lines, or shelling our cities and public depots of military and naval supplies. The efficiency of mortar batteries against shipping is acknowledged by all military engineers; it is fully appreciated by the navies of all nations and they are comparatively inexpensive.

Our guns and mortars must be capable of piercing the sides of his ironclads and of breaking in his decks, and they must be mounted in numbers sufficient to make it impossible for any of his fast-running war steamers to get past our works.

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—H. G. Wright, *Chief of Engineers, Brig. and Bvt. Major General.*

Annual report for 1884, 4, 5, 6, 7, 8, 9. Report of the Chief of Engineers, United States Army. Washington, D. C., Oct. 15, 1884.

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SEACOAST AND LAKE-FRONTIER DEFENSES.

It would doubtless be superfluous at this late date to explain the principles upon which the system of our seacoast fortifications should be based but for the persistent misrepresentations made by individuals whose positions unfortunately enable them to mislead public opinion.

The sole object of seacoast forts and batteries, as constructed by the Corps of Engineers, has been to prevent hostile fleets from approaching near enough to our important seaports to destroy shipping, public establishments, such as navy yards, etc., and lay our cities under contribution. The contribution which could be levied from New York alone would probably pay four or five fold the cost of all the fortifications of the important harbors of the country.

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The present system, by the use of torpedoes—that is, submarine mines anchored in the channels—enables the defense to stop the ingress of hostile fleets until the mines shall have been removed, or, at least, the means of exploding them destroyed.

These mines consist of a shell of iron inclosing a charge of dynamite, guncotton, or explosive gelatin, and are so arranged as to make it impossible for a vessel to enter without touching one or more.

The explosion is regulated by electric currents communicated from the shore through cables, so as to take place from simple contact of the vessel with the torpedo, or by the act of the electrician, as he may choose; so that a friendly vessel shall pass over unharmed, while that of an enemy immediately following would be destroyed.

But unless these lines of torpedoes are defended by guns of such power as to pierce the armor of ironclads, they may be countermined and removed with impunity; or the cables and other electrical communications may be dragged for and the whole system rendered innocuous.

The rooms which contain the electric apparatus and whence the cables start, as well as the tunnels through which these pass into the water and communicate with the mines, require to be shot and shell proof, for a solitary missile penetrating either the operating room or the cable tunnel might destroy electric connection with the mines and render the entire system useless.

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The persons who tell us to wait for war, and then to improvise a sand heap as a fort without making any provision of emplacements for the guns or for their service, either assume the people to be profoundly ignorant, or are so themselves.

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Some of the guns on land should at least equal the most powerful afloat on the fleet. The armor on land should be much heavier than that carried by ships. The heavier guns of the batteries should be so protected as not to be reached except by a shot coming through the port. It would be very bad judgment, in order to save a little armor, not to make the more important batteries invulnerable to the fire of the fleet.

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Those persons are greatly in error who imagine that by diplomatic delays war may be averted until proper preparations for defense can be made. Were we as well prepared as many other nations, this might be true; but while a diplomatic delay of a few months might be necessary for a naval power to commission

HOME PORTS.

Kennebec River.
Portland.
Portsmouth.
Boston.
New Bedford.
Narragansett Bay.
Eastern entrance to Long Island Sound.
Eastern entrance to New York.
Southern entrance to New York.
Delaware Bay.
Baltimore.
Entrance to Chesapeake Bay.
Hampton Roads.
Potomac River.
Cape Fear River.
Charleston.
Savannah.
Key West.
Tampa.
Pensacola.
Mobile Bay.
Mississippi River.
Galveston.
San Diego.
San Francisco.
Columbia River.
Puget Sound.
Lake ports.
Kiska Island.

INSULAR PORTS.

Guantanamo.
San Juan.
Guam.
Subic Bay.
Manila Bay.
Pearl Harbor and Honolulu.

ISTHMIAN CANAL PORTS.

Colon.
Panama.

its ships, it would require a great many years for us to get together modern guns, without reference to constructing forts and batteries for their reception.

Past events by no means justify the assertions made that our cotton and grain have become so necessary to the nations that they could not engage in war with us for a short period without the interruption of their supplies of these articles. It seems to be forgotten that a descent upon our coast, to hold our unprotected cities under the guns of a hostile fleet, would consume but a few months, and in the meantime cotton and grain in sufficient quantity might be obtained elsewhere. Let it be well understood that the modern system is to make war sudden, sharp, and decisive, and to make the beaten party pay expenses.

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If a future struggle for the supremacy in shipping should result in war, let us at least enter into it with our harbors and cities well protected, so that our merchantmen, and even naval vessels, may have places of refuge without fear of capture at our wharves.

Should, however, the evil day come and find us without modern guns, without sufficiency of torpedoes, without fortifications except the sand heap which forms the staple quotation, without emplacements for the guns if we had them, or magazines, or machinery for loading or maneuver, or any facilities whatever for shelter of guns and cannoneers against shells and machine guns, it is to be feared we would not cordially welcome the prophet who, having opposed timely preparations promised that in the supreme moment, when the hostile ironclads, whatever their strength and power, should approach the harbor of New York, they would be turned back somehow, without explaining how, by "Yankee energy, Yankee skill, Yankee inventive genius." It is to be feared that the first flash of the monster guns would dissipate this oratorical vapor emitted when the danger was far off, and leave the deluded hearers to realize the fate of the blind who follow the blind.

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—JOHN NEWTON, *Chief of Engineers, Brig. and Bvt. Maj. Gen.*

Annual report for 1888, 5. Report of the Chief of Engineers, United States Army. Washington, D. C., Oct. 1, 1888.

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SEACOAST AND LAKE-FRONTIER DEFENSES.

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Neglect of any structure, however massive or well built, results in more or less rapid deterioration, and we find to-day everything connected with our permanent defenses, which are dependent upon annual appropriations for their maintenance and repair, going to rack and ruin; slopes overgrown with grass and weeds and gullied by the rain; walks and roads ragged and untrimmed and full of holes and breaks; ditches and drains filled up or fallen in, and pools of stagnant water on the parades and in the casemates; the sewers in bad order, with the consequent evils; mortar and cement falling from the joints of masonry for want of repointing; timber gun and ammunition platforms rotten or decayed, and permanent concrete or masonry platforms settling or out of plumb, thus preventing the proper service of the guns; casemates and quarters leaky, unhealthy, and uninhabitable; magazines damp and useless; revetment walls on water fronts falling down, and waves making serious and rapid encroachments on valuable ground, thus impairing eligible sites for future works, and generally about the ungarrisoned forts an appearance of total abandonment and decay, and from the commanders of garrisoned forts continued and urgent appeals to keep the works in proper repair for the comfort and convenience of the garrison and the efficient use of the armaments.

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—THOS. LINCOLN CASEY, *Brig. Gen., Chief of Engineers.*

GUNS.

The gun defense of a port of first importance should consist of guns of not less than 12-inch caliber, 12-inch mortars, and suitable rapid-fire guns for the defense of the mine fields.

Ten-inch guns are sufficient to cover channels liable only to cruiser attack.

Six-inch guns should be used for the protection of places subject to naval raids and the special case of mine fields at distant ranges.

Three-inch guns should be used for the protection of mine fields at ordinary ranges.

No fixed rule for determining the number of guns required to give an adequate protection, and in arriving at a conclusion as to what should constitute the defense, the following considerations have been accepted, which tend to diminish the number recommended by the Endicott Board without decreasing in any way the protection to the harbors.

1. The development of a system of range finding, fire control and direction, much more efficient than could be anticipated at the time of the Endicott Board, which gives the land gun a very great advantage in accuracy of fire over the gun afloat, especially at the longer ranges.
2. The increased power developed in guns of a given caliber.
3. The adoption of the disappearing carriage for the higher-caliber guns, thereby attaining an increased rate of fire.
4. Ships engaged in an attack of a fortified position must have ample room in which to turn, and as war vessels are being constructed larger and of deeper draft, the defenses required for narrow and shallow channels, whether natural or dredged, may be diminished, since the heavier ships are excluded.
5. If the armament will compel the enemy to land in order to effect its capture, it has fulfilled its function, and any increase in armament thereafter is an unwarrantable expense in material and personnel.

SUBMARINE MINES AND TORPEDOES.

Are essential features. Suitably equipped boats and barges necessary. Boats already employed insufficient. Claims of Navy to command of seagoing defenses recognized, and also the general inadvisability of assigning naval units to special stations. Because of conditions in Long Island Sound, Puget Sound, and Golden Gate defenses, submarine mines can not be relied upon. Navy should assign submarine boats or other suitable vessels to such points.

Board recommended experiments with automobile torpedoes.

ELECTRICAL APPLIANCES.

Central plant obligatory, with reserve, scattered, or individual smaller units.

SYSTEM OF RANGE FINDING, FIRE CONTROL AND DIRECTION.

Central fire control essential. Expense a very small percentage of the cost of the whole fortifications controlled. Suitable boats and appliances necessary for submarine cable system.

SEARCHLIGHTS.

Experience has emphasized their importance.

SECURITY AND INFORMATION.

Defenses should communicate with each other with suitable signaling apparatus, including wireless telegraph, military, or commercial lines. Special report submitted laying stress on U. S. control of communications with Isthmian America.

GOVERNMENT ENCOURAGEMENT OF PRIVATE ESTABLISHMENTS IN THE SUPPLYING OF WAR MATERIAL FOR COAST DEFENSE.

Experience has not shown the necessity for the Government's embarking in the manufacture of any class of material which has thus far been furnished exclusively by private establishments.

There is certain ordnance material for which there is an increased need in time of war, and it is imperative that adequate provision should be made to supply the consequent demand. This end can be accomplished only by establishing in advance plants in excess of peace requirements and which, of necessity, must be partially unemployed in time of peace. It is unreasonable to expect the private manufacturers to maintain such plants.

HARBOR FLOATING DEFENSE.

An adequate naval battle fleet required. Floating defense scheme advocated by the old Endicott Board deemed unwieldy and of little value.

ARMAMENT RECOMMENDED.

The board presents a table covering armament details ranging from 16-inch guns downward, embracing mortars, submarine defenses, power plants, searchlights, etc.

Total of detailed estimates—home ports, $50,879,339; insular ports, $19,873,895 (including ammunition, $2,900,000); Isthmian Canal ports, $4,827,682.

ORDER IN WHICH DEFENSES SHOULD BE COMPLETED.

(a) Reserve ammunition supply; (b) fire-control and power installations for existing works; (c) torpedo defense to be completed. Urgent that additional guns and emplacements recommended for important channels should be commenced at an early date in view of the number of years required to complete such work.

Among the places recommended to be defended are the following, in the order desirable:

Entrance to Chesapeake Bay.
Eastern entrance to Long Island Sound.
Puget Sound.
Subic Bay.
Guantanamo.
Entrance to Manila Bay.

Adequate personnel should be provided.

Order in which the actual work should be taken up should be left to discretion of the Chief of Engineers, with cooperation, etc., of Chief Signal Officer, Chief of Ordnance, and Chief of Artillery.

MEMBERS OF THE BOARD.

Wm. H. Taft, Secretary of War, president of the board; Adna R. Chaffee, lieutenant general, U. S. Army; J. C. Bates, major general, U. S. Army, Chief of Staff; Charles M. Thomas, rear admiral, U. S. Navy; J. P. Story, major general, U. S. Army; A. W. Greely, brigadier general, Chief Signal Officer; William Crozier, brigadier general, Chief of Ordnance; A. Mackenzie, brigadier general, Chief of Engineers; Samuel M. Mills, brigadier general, Chief of Artillery; C. S. Sperry, captain, U. S. Navy; George W. Goethals, major, General Staff, secretary of the board.

CONTENTS OF REPORT.

Message of President Roosevelt to Congress, Mar. 5, 1906: letter from Secretary of War Wm. H. Taft, transmitting report of the board, report of the board.

Report of Committee No. 1 composed of: Maj. Gen. John P. Story, U. S. Army; Brig. Gen. William Crozier, Chief of Ordnance; Brig. Gen. Alexander Mackenzie, Chief of Engineers; Brig. Gen. Samuel M. Mills, Chief of Artillery; Capt. Charles S. Sperry, U. S. Navy; Maj. George W. Goethals, General Staff, recorder. Reporting on the following subjects: (1) The study of exposed ports of our seacoast, including insular possessions, and information as to increase of existing defense required and additional ports and harbors to be defended. (2) The number and caliber of high-power and rapid-fire guns necessary to be emplaced to give a reasonably good defense at all points recommended for defense, with the cost of said guns, mounts, and emplacements. (3) Service and reserve ammunition supply and storage magazines. (4) The capacity of gun and gun-carriage works in the United States.

Report of Committee No. 2 composed of: Maj. Gen. John P. Story, U. S. Army; Brig. Gen. Adolphus W. Greely, Chief Signal Officer; Brig. Gen. William Crozier, Chief of Ordnance; Brig. Gen. Alexander Mackenzie, Chief of Engineers; Brig. Gen. Samuel M. Mills, Chief of Artillery; Capt. Charles S. Sperry, U. S. Navy; Maj. George W. Goethals, General Staff, recorder. Reporting on the following subjects: (1) Torpedo defense, fixed and automobile. (2) Power plants and use of electricity for posts, armament, and accessories. (3) Installations for fire control. (4) Searchlights. (5) Security and information.

Report of Committee No. 3 composed of: Rear Admiral Charles M. Thomas, U. S. Navy; Maj. Gen. John P. Story, U. S. Army; Brig. Gen. Adolphus W. Greely, Chief Signal Officer; Brig. Gen. Alexander Mackenzie, Chief of Engineers; Brig. Gen. Samuel M. Mills, Chief of Artillery; Capt. Charles S. Sperry, U. S. Navy; Maj. George W. Goethals, General Staff, recorder. Reporting on: Floating defenses, consisting of retired battleships, monitors, etc., for defense of harbors, particularly of wide entrances, and the auxiliary use of scout boats, torpedo boats, and submarine boats; the number and cost of such boats and other floating defenses.

FMC. OPERATIONS ON DEFENSES IN GENERAL, 1866-1912.

(See also FMA, p 1801, of this Index.)

1870. Results of a series of experiments with modern projectiles upon iron shields and earth and sand parapets. **70,** 4. Co.. . G. Barnard, Lt. Col. H. G. Wright, and Capt. P. S. Michie ordered to determine by actual inspection the extent to which iron has been introduced into seacoast defenses by the maritime powers of Europe. **70,** 10.

1872. BE. organized in June, 1865. The projects for the application of torpedoes to H. defense was considered, the commanding officer of the engineer battalion being a member for that purpose. **72,** 25.

1873. $300,000 app. for torpedoes for H. defense and preservation of the same, and for obtaining the latest information concerning the electrical apparatus, experiments, conditions of service, and the systems of torpedo defense in other countries. Majs. T. L. Casey and H. L Abbot ordered to Europe to obtain this information. **73,** 25.

1874. Some results of torpedo experiments. **74,** 30.

1875. Torpedo experiments continued, number of trained men necessary to plant mines. **75,** 29.

1876. Experiments with the iron target, torpedo crate, torpedo cases, etc. **76,** 30. Comparison of defensive armament with that of an enemy's offensive armament. Cost of some of the British ships of war. **76,** 5; **79,** 6.

1877. Torpedo trials: Submerged ring, torpedo target, torpedo material, and reduction of data, with recom. **77,** 25. Recom. of the board. **77,** 27; **78,** 31.

1878. Project for the year 1879–80 presented. **78,** 34. Torpedo trials, submerged ring, torpedo target, torpedo cases, circuit closers, the telephone, with recom. **78,** 30. Current observations in reference to torpedo defense, by Lt. A. H. Payson. **78,** 1304.

1879. Some results of the analysis of subaqueous explosions and of electrical fuses, with recom. **79,** 35.

1880.[1] Seacoasts, proper method of defense. Comparison of the methods adopted by other countries for seacoast defenses. **80,** 4; **81,** 4. Results of investigations of the sympathetic explosions of dynamite and other experiments. **80,** 57. Plans for coast defenses, questions on R. and H. imp., torpedo defense, with results of the investigations and recom. of the board. **80,** 54; **81,** 56.

1881. Report by Lt. Col. Q. A. Gillmore on the condition of our seacoast defenses and the importance of strengthening them, involving the following subjects: An unprotected seacoast; character of the attack; requirements of a good defense; functions of the Regular Army and militia; defense by a H. fleet alone; defense by fortifications and their accessories; a perfect defense; torpedo boats and their achievements; with a brief description of Buffington's and King's counterpoise gun carriages, with drawings. **81,** 399.

1882. Report by Lt. W. H. Bixby of a journey made, 1881–82, in Belgium, Holland, Germany, and England, to obtain information in relation to turrets, armor plate, and the service of heavy guns of seacoast defenses. **82.** 435. Coast defenses, torpedo defenses, and other subjects considered. **82,** 56. Report, dated Nov. 30, 1881, on the condition of the fortifications, and what number of them, if any, could be dispensed with. **82,** 411.

1883. Seacoast and lake frontier defenses considered. Estimated cost of fortifications of eight principal ports, $60,000,000. Itemized estimate of app. required for 1885–86. **83,** 4. Coast defense, torpedo defense, etc., considered. **83,** 15.

1884. Coast defenses, consideration of. Elements of defense for the entrance to a H. given, and est. cost of heavy guns and emplacements needed for localities mentioned. $75,000 allotted for torpedo defense, experiments continued with explosives, with results and est. required. Summary of operations of the board: Aug. 30, 1884, the board submitted estimates for heavy guns and emplacements for the places given. **84,** 55.

1885.[1] Preparation of report by Capt. Bixby upon his investigations in Europe. **84,** 421. Operations restricted to those necessary for the preservation and repair of existing works. The subject of the defensive system of the country, as far as regards the ports at which fortifications or other defenses were most urgently required, referred by Congress to a board of which the Sec. of War was president. Est. cost for the modification and repair of existing works for 1886–87, $1,274,000. **85,** 4. Capt. Bixby's report upon investigations in Europe completed. **85,** 421. Fortifications, R. and H., coast defenses, and torpedo defense considered; experiments made with the Sims movable torpedo and new explosives. **85,** 48.

1886. Coast defense, torpedo defense, with results of experiments. **86,** 48. Comparisons of fortifications of the present day, both for offense and defense, with those of 1860. The largest gun in service, 1860, was the 10-inch Rodman smooth bore, the energy of whose projectile was 2,000 f.-t., while the guns of the "present" day deliver 45,000 f.-t. of energy, and are steadily increasing in power. Discussions of a naval attack and coast defenses, localities given in order of urgency for defensive armament. The defenses and their accessories discussed, comparison of the U. S. 12-inch B. L. rifle, cast iron, and the Krupp's 12-inch B. L. rifle, steel; other calibers discussed; torpedo system considered among the most important means of conducting an active defense of the coast. List of ports, with description of fortifications and other defenses with reference to armament, mines, torpedoes, etc. Practical measures for obtaining the appliances for defenses. Recapitulation of est. **86**, 499–525.

1887. Est. for constr. of gun and mortar batteries, torpedo casemates and galleries, and for purchase of torpedo material for the defense of the chief seaports. **87**, 4.

1888. Acts of 1876–80 app. each year for the protection, preservation, and repair of fortifications and other works of defense, $100,000; acts of 1881–84, an., $175,000; and act of 1885, $100,000. This latter was the last app. and was practically exhausted by the end of the year for which it was app. Est. of app. required for 1889–90, $4,952,000. **88**, 4.

1889.[1] Extract from report of Board of Engineers with reference to the existing contracts for making armament. Main features of the proj. of the board on fortifications, 1885, and permanent Board of Engineers, with est.; $200,000 app. for torpedoes for H. defense and $250,000 for casemates and cable galleries for operating submarine mines Repair and preservation of Fort Marion, St. Augustine, Fla., advised; $117,000 app. for sea walls and embankments. Est. given of app. required. **89**, 4.

1890. Est. for defensive works; $117,000 app. for sea walls and earth embankments at Fort Niagara, Davids Isld., and Governors Isld., N. Y. **90**, 4.

1891. Localities named at which app. are to be expended and where defensive works are in progress. **91**, 4.

1892. Est. and proj. given. **92**, 4.

1893. Proposed new works. Table giving locality and armament for which funds have been allotted. **93**, 4.

1894. Allotments made. **94**, 4, 11.

1895. Proj. for defense prepared for localities named. Places named where allotments have been made for emplacements and additional platforms; 25 casemates completed at places named, and 3 more being built; $20,000 app. for submarine-mine material and necessary appliances. **95**, 4. Places named where allotments have been made for beginning new works. **95**, 12. Places named where work of preservation and repair of fortifications has been carried on during the year. **95**, 13. $150,000 app., 1894, for sites for defenses at Narragansett B., Baltimore H., and Charleston H. **95**, 14.

1896. List of places named where detailed proj. for artillery defenses have been prepared. Use made of the existing old-type fortifications. **96**, 7. $500,000 app. for sites; negotiations in progress. Work in progress on sea walls and embankments. Emplacements named where allotments have been made. Statement showing the conditions of the various emplacements Sept. 15, 1896. Total armament proposed in the proj. for defenses. **96**, 10. $100,000 app. for submarine-mine defense; 28 casemates completed, 1 more being built. **96**, 11.

1897. Localities named where title to sites has been obtained. Table giving emplacements provided for. Work in progress at 22 ports. Objections given to the contract system as applied to fortifications. Statement showing the condition of the various emplacements at the close of the fiscal year. **97**, 10. $150,000 app. for submarine-mine material; 4 casemates, 2 special torpedo storehouses and storerooms being built. **97**, 11.

1898. Localities named where proj. for permanent and temporary coast defenses have been prepared. Statements of app. for gun and mortar batteries and of the type of gun, with total guns and total emplacements provided. Tables giving total number of emplacements provided for, and either completed or under constr. at the beginning of the year. Nearly all the guns mounted transferred to the artillery. **98**, 8. Discussions of the duties of a fortress commander as applied to the defenses of New York H., by Brig. Gen. G. L. Gillespie. **98**, 579.

Dynamite batteries: These batteries constr. under the Ordnance Department in past years at locations named; $150,000 app. in 1898 for work in San Francisco H.: work in progress. Localities given where batteries will be erected. **98**, 11.

Submarine mines: List of some of the torpedo material purchased.

Preservation and repair of fortifications: Necessary minor repairs made.

Sea walls and embankments: $55,000 app. for repairs at places named.

Sites: Localities given where title has been obtained to sites.

National defense: Allotments and their objects for 1898 given. **98**, 14.

1899. Thirty localities named where proj. for defense have been adopted, also places where considerable study has been given coast defenses of insular possessions. Work has been carried on at 25 localities, at nearly all of which sufficient heavy guns and mortars now installed permit of an effective defense against naval attack. Temporary batteries maintained till the close of the war ith Spain. **99**, 9.

Gun and mortar batteries: The contract work authorized by Congress completed except one contract. Discussion of contract work.

Dynamite batteries: Work completed at San Francisco; provision yet remains for work at Sandy Hook, and other places given where contracts have been made under act of Sept. 22, 1888.

Range and position finders: The question of the type of finder best adapted not yet definitely settled. **99**, 12.

Preservation and repair of fortifications: Repairs confined mainly to engineer material in the new seacoast batteries. The question of waterproofing magazines to be further considered.

Supplies for seacoast defenses necessary for operating electric light and power plants, no funds available. **99**, 14.

Sea walls and embankments: $2,500 app. Work carried on at Fort Schuyler. **99**, 14.

Sites: $300,000 app., negotiations in progress at places given. **99**, 14.

Submarine mines: $1,386,000 app. for torpedo material and the planting and maintaining of the mine fields; $50,000 app. for torpedoes for H. defense, and applied to purchase of additional torpedo material and constr. of additional storage facilities for material on hand, and torpedo experiments. The practical experience gained with the adopted torpedo system during the war with Spain invaluable. **99**, 15.

National defense: App. and purposes given. **99**, 15.

[1] **1900.** Localities named where proj. for defense have been adopted. **00**, 6. $1,800,000, the est. cost for defense of San Juan, Porto Rico. Rapid increase in the resisting power of armor plate in ship constr., necessitating corresponding changes in the details of coast defenses. The seacoast defenses are now about 50% completed. **00**, 7.

Gun and mortar batteries: App., 1890 to 1900, $22,142,212.62, not including $306,805.04 for national defense. Tables giving type of gun and carriage, with total number of each provided, also emplacements provided. Table giving total number of emplacements of every kind provided for by all app., also their condition. **00**, 7.

Dynamite batteries: $180,000 app. for pneumatic dynamite batteries; work begun at Sandy Hook, and plans in progress for other places given. **00**, 10.

Range and position finders: $150,000 app. for 25 additional range-finder stations; 30 previously constructed; total number projected, 177. **00**, 10.

Preservation and repair of fortifications: Waterproofing, and care of engineer material the principal work. **00**, 11.

Supplies for seacoast defenses: $25,000 app. for supplies for light and power plants. **00**, 11.

Sea walls and embankments: $200,000 app. for places named; work in progress. **00**, 11.

Sites: $200,000 app.; sites bought and proceedings instituted for others. **00**, 12.

Submarine mines: $50,000 app.; work in progress equipping all Hs. with a full complement of torpedo material. **00**, 12.

1900–01. Continuance of study of existing torpedo system in the light of reports submitted by officers of the Corps of Engineers in charge of submarine-mine defenses during Spanish-American War. **01**, 5, 695.

1900–01. Proj. for 31 localities adopted. List of same given. Detailed proj. for defense of entrance to Chesapeake B. at Cape Henry, Va., approv. Sec. of War. Several additional localities under consideration. Study of defenses of Porto Rico and Hawaiian Islands. Est. for San Juan, P. R., $1,800,000 prepared, pre. proj. for Pearl H. and Honolulu, H. T., available. **01**, 6. Defenses of U. S. about 50% done. During past year considerable progress made toward installation of adequate rapid-fire armament. Existing app. proj. for seacoast defense contemplate mounting about 464 heavy guns of 8, 10, 12, and 16 inch caliber, about 1,041 R. F. guns from 6-pounder to 6-inch caliber, and of about 704 mortars; total cost est., $50,000,000. Up to present time $23,757,009.02 app. $992,000 spent for reconstr. and repair of damaged fortifications at Galveston in hurricane of Sept. 8, 1900. Table showing guns and carriages provided for by Ordnance Department and emplacements provided for by Engineer Department. During year following armament added: Fifteen 12-inch, seven 10-inch, eleven 8-inch, 35 R. F. guns, and 23 mortars. Existing contract Venable Constr. Co., Atlanta, Ga., for constr. of gun and mortar batteries at Key West, Fla., abandoned. Work readvertised and let to L. L. Leach & Sons,

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[1] Up to June 30, 1900, provision had been made for emplacing 309 heavy guns, 368 rapid-fire guns, and 372 12-inch mortars.

The status of emplacements for which funds had been provided by Congress up to June 30, 1900, was as follows:

	12-inch.	10-inch.	8-inch.	Rapid fire.	12-inch mortars.
Guns mounted	57	105	[2] 75	53	240
Ready for armament	23	8	16	[3] 189	84
Under construction	13	9	3	81	48
Not yet begun	....	....	....	45	....
Total	93	122	94	368	372

[2] Ten of these, mounted temporarily, have since been dismounted.

[3] Including seventy 6-pounders not requiring permanent emplacements.

Chicago, Ill. Est. of $4,000,000 sub. for contr. work on gun and mortar batteries in accordance with proj. Table of guns provided and emplacement work done. 01, 5–10.

1901–02. Board on torpedo system dissolved. Records sent to Artillery School of Submarine Defense, Willets Point, N. Y. 02, 6. Defense of Great Lakes and St. Lawrence R. under consideration. Proj. for defense of Porto Rico, Hawaii, Guam, Manila, and Subig B. approv. by Sec. of War. Defense board similar to Endicott Board to devise a modern-defense scheme necessary due to rapid development of defense and attack methods since Endicott Board. Existing proj. for seacoast defenses comprise 356 heavy guns of 8, 10, and 12 inch caliber, 1,294 R. F. guns from 2.24 to 6 inch caliber, and 544 mortars. Total engineering cost, $50,000,000. Act May 25, 1900, does not permit constr. of mortar batteries. Summer, 1901, satisfactory tests made of mortar batteries. 02, 8. Table of guns provided and emplacement done. 02, 9. Ordnance Department designing 5 R. F. guns to fit emplacements for Brown segmental guns. 02, 10. Added during year: Eight 12-inch guns, three 8-inch guns, 20 R. F. guns, and 34 mortars. 02, 11. Contract for Key West work let L. L. Leach & Son (failed), annulled. Work to be done by hired labor and charged against contractor's bondsmen. 02, 11. Est. $4,000,000 made for continuing constr. gun and mortar batteries. 02, 11.

1902–03. In the absence of legislation, a mixed board of Engineer and Artillery officers by au. Sec. of War has partly planned and reported upon emergency defense of most important insular Hs. Suggested to add a naval officer and that board meet in Washington, D. C. 03, 8. Defenses more than 50% done. Existing proj. for defense comprise 358 guns of 8, 10, and 12 inch caliber, 1,294 R. F. guns from 2.24 to 6 inch caliber, and 532 mortars. 03, 9. Added during year: Twelve 12-inch, three 10-inch, four 8-inch, 70 R. F., and 31 mortars. 03, 12. Est. of $4,260,000 for contr work. 03, 12.

1904. Existing proj. calls for three hundred and sixty-four 8, 10, and 12 inch guns, 1,296 R. F. 2.24 to 6 inch, and 524 mortars. Provision made for emplacing 334 heavy guns (including 26 temporary emplacements), 587 R. F. (including 1 temporary emplacement), and three hundred and seventy-six 12-inch mortars. Added during the year: One 12-inch, four 10-inch, 7 R. F., and 22 mortars. Est., $4,000,000. 04, 6, 7, 8.

1904–05. A board, known as the National Coast Defense Board, with Sec. of War as its president, to study modern defenses, constituted by Executive order. 05, 7. Guns added during year: Seventeen mortars, eight 12-inch guns, one 8-inch gun, and 46 R. F. guns. Est., $4,000,000. 05, 8.

1905–06. Board submitted final report Feb. 1, 1906. 06, 5. (See Part 5, FMB, p. 1821, of this index.)

Est., $16,052,431 will be required. 06, 6. Guns added during year: Eight mortars, four 12-inch guns, and 94 R. F. guns. 06, 6. Est., $4,247,400 06, 7.

1906–07. Guns added during year: One mortar, three 10-inch guns, and 130 R. F. guns. 07, 7. Est., $4,247,400. 07, 7.

1907–08. Added during year: Four 10-inch guns and 51 R. F. guns. 07, 11. Table, status of permanent work completed, or in progress. 07, 10.

1908–09. Added during year: Three 8-inch guns and 28 R. F. guns. 09, 12.

1909–10. Added during year: Three 10-inch guns and 46 R. F. guns. 10, 14.

1910–11. Added: Four 10-inch guns and 28 R. F. guns. 11, 9.

1911–12. Total app., $20,008,664.80. Est., $100,000 submitted. 12, 8.

FMD. PRESERVATION AND REPAIR.

(See also FMA, p. 1801 of this Index.)

Part.	Title.
1	Preservation and repair.
2	Preservation and repair, insular.
3	Preservation and repair, torpedo structures.
4	Preservation and repair, torpedo structures, insular.

Part 1, FMD. Preservation and Repair.

1900–01. Operations limited mainly to the preservation of engr. material in the new batteries, to the application of remedial measures for imp. the conditions of the magazines of the earlier works as regards dampness, and to the care and preservation of the torpedo material stored at each H. Est., $300,000 for next year, as $100,000 of past year nadequate. **01, 11.**

1901–05. $300,000 additional urgently needed. **02,** 12; **03,** 12; **04,** 9; **05,** 10.

1905–06. To keep fortifications in effective condition an average expenditure of not less than $25,000 a month is essential. **06,** 8; **07,** 9; **08,** 13; **09,** 14; **10,** 16; **11,** 12; **12,** 11.

Part 2, FMD. Preservation and Repair of Fortifications, Insular Possessions.

1908–09. Est. prepared for preservation and repair of completed batteries, by minor repairs, painting, etc. $900 for Guantanamo B., Cuba; $1,500 for Hawaiian Islds.; and $14,000 for Philippine Islds. **09,** 19; **10,** 20; **11,** 21; **12,** 19.

Part 3, FMD. Preservation and Repair of Torpedo Structures.

1904–05. New torpedo-defense structures are built of timber and corrugated iron, and are liable to more rapid deterioration and decay than the more costly structures of concrete and masonry. An est. of $50,000 submitted for preservation and repair. **05,** 12; **06,** 9; **07,** 11; **08,** 16; **09,** 17; **10,** 18; **11,** 15.

Part 4, FMD. Preservation and Repair, Torpedo-Defense Structures, Insular Possessions.

1908–09. In order to provide for maintenance in proper condition of the numerous structures already erected in connection with torpedo defense, est. $1,000 submitted for Philippine Islds., and $500 for Hawaiian Islds. **09,** 19; **10,** 20; **11,** 21; **12,** 20.

FME. RANGE AND POSITION FINDERS, AND FIRE CONTROL.

(See FMA, p. 1801 of this index.)

Part.	Title.
1	Range and position finders, etc.
2	Fire control at batteries, insular.

Part 1, FME. Range and Position Finders.

1900–01. Objection made by experts to the use of high towers on low sites. Work on towers stopped till views of artillery could be obtained. Est. of $150,000 submitted. **01,** 11.

1901–02. Progress made in systematizing matter of fire control. Division of authority among Engr., Ordnance, Signal, and Artillery Departments. Steelwork delayed by steel market. Nine fire comm., 45 battery comm. sta. done; 12 fire comm., 3 battery comm. sta. under contract. Experiments under way to make smaller towers. **02,** 11, 12.

1902–03. Eleven fire comm., 55 battery comm. sta. completed; 22 f. c. and 55 b. c. under constr. **03,** 12.

1904. Horizontal-base system of position finding recently adopted by Artillery; boards of 2 traveling Artillery officers, associated with local Artillery commanders, and district Engr. officers at each fortified H. on the Atlantic and Gulf coasts prepared necessary schemes of base-end stations. **04,** 8.

1904–05. Tentative fire-control schemes for existing batteries adopted by Chief of Artillery, and detailed plans covering engineering part of work prepared. **05,** 9.

1905–06. $590,000 allotted from act Mar. 3, 1905, applied at New York, Boston, and Portland. Plans and est. for work to be done with app. of $700,000, act June 25, 1910, in preparation. **06,** 7.

1906–07. Engr. work in progress under allotments. **07,** 8; **08,** 12; **09,** 13; **10,** 15; **11,** 10; **12,** 8, 9.

Part 2, FME. Fire Control at Batteries, Insular Possessions.

1905–06. In order that the high-power batteries now building and those to be built during the next fiscal year may be equipped with adequate fire-control systems, an est. amounting to $752,360 is submitted to cover cost of Engr. work. $96,480 for Guantanamo B., $165,120 for Honolulu and Pearl H., $329,480 for Manila, and $161,280 for Subic B. **06,** 11; **07,** 12; **08,** 17; **09,** 18; **10,** 20; **11,** 22; **12,** 20.

FMF. SEARCHLIGHTS AND ELECTRICAL EQUIPMENT.

(See FMA, p. 1801 of this index.)

Part.	Title.
1	Searchlights and electrical connections.
2	Reserve lights.
3	Searchlights, insular.
4	Electrical installations.
5	Electrical installations, insular.

Part 1, FMF. Searchlights and Electrical Connections.

1900–01. Work on installation of searchlights at defenses of New York H. well advanced. Becoming important to inaugurate systematic installation of searchlight apparatus for night defenses. Economy in installation and the keeping of electric plants in good order in time of peace are promoted by habitually using fortification plants for post illumination also. Ests. $500,000 for installation of searchlights and $500,000 for installation of post mains and conduits urgently recom. **01,** 13.

1901–06. Est. $500,000 submitted. **02,** 14; **03,** 14; **04,** 9; **05,** 10; **06,** 8. National Coast Defense Board est. cost of sufficient searchlights for coast of U. S. as $2,987,700. **06,** 8.

1906–07. Est. $1,000,000 submitted, **07,** 9.

1907–08. Eight projectors of a new type developed abroad and 2 of domestic manufacture purchased and issued to troops for test. Est. $907,000 submitted. **08,** 13.

1908–09. Est. $897,009 submitted; reduced by Sec. of War to $50,000. **09,** 14.

1909–10. Est. $516,000 submitted; reduced to $50,000. **10,** 16.

1910–11. Est. $102,000 submitted. **11,** 11.

1911–12. Est. $250,000 submitted. **12,** 9.

Part 2, FMF. Reserve Lights.

1908. An est. $19,500 submitted to supply reserve electric lanterns in sufficient quantity to all batteries. **09,** 17; **10,** 17; **11,** 12; **12,** 11.

Part 3, FMF. Searchlights, Insular Possessions.

1906. For the purchase and installation of searchlights at the defenses of the insular possessions, est. of $500,000 is submitted, $84,000 to be applied to Guantanamo B., Cuba; $57,000 to San Juan, P. R.; $95,000 to Pearl H. and Honolulu, Hawaii; $57,000 to Guam; $95,000 to Subic B., P. I.; and $114,000 to Manila, P. I. **07,** 12; **08,** 17; **09,** 18; **10,** 21; **11,** 20; **12,** 18.

Part 4, FMF. Electrical Installations.

1906–07. The National Coast Defense Board est. that $5,216,031 would be required to furnish necessary electrical equipment for defenses in addition to current required for searchlights. **07,** 8; **08,** 12; **09,** 12; **10,** 15; **11,** 10; **12,** 9.

Part 5, FMF. Electrical Installations, Insular Possessions.

1906–07. National Coast Defense Board est. $788,713 would be required to furnish necessary electrical equipment for defenses of insular possessions, in addition to current required for searchlights. Ests. $103,727 for Guantanamo B., $34,469 for Honolulu and Pearl H., $259,080 for Manila, and $105,716 for Subic B. submitted. **07, 12.**

1907–08. Funds provided; work in progress. For continuation est. $230,638 submitted, $14,469 for Hawaiian Islds. and $216,169 for Philippines. **08, 17.**

1908–09. Est. $127,346 for Philippines submitted. **09, 18.**

1909–10. Est. $171,962 for Philippines submitted. **10, 19**

1910–11. Est. $25,000 for Hawaiian Islds., $21,614 for Philippines. **11, 20.**

1911–12. Est. $34,469 for Hawaiian Islds. **12, 18.**

FMG. SITES, BATTERIES, AND EMPLACEMENTS.

(See FMA p. 1801 of this Index.)

Part.	Title.
1	Sites, etc.
2	Sites, insular.
3	Dynamite batteries.
4	Modernizing old emplacements.

Part 1, FMG. Sites.

1900–01. Negotiations continued for acquisition of sites at Boston H. (2 sites), Narragansett B. (3 sites), New York H. (extension of Fort Newton), Port Royal, S. C, San Francisco H., San Diego H., St. Johns R., Fla., Fort St. Phillips, La., and Cape Henry, Va. Acquisition of 1 site at Narragansett B., 2 tracts at Fort Newton, 1 site at San Francisco, and remainder of site required at Port Royal, S. C. completed during year. Est. $2,000,000 submitted. **01,** 12.

1901–02. Negotiations for site at Portland, Me. Est. $2,000,000 submitted. **02,** 13.

1902–03. Site at entrance to Long Isld. Sound and 1 tract at Fort Hunt, Va. Est. $2,000,000 submitted. **03,** 13.

1903–04. Negotiations for sites at defenses of Kennebec R., Me.; Charleston, S. C.; Mobile, Ala.; the Columbia R., and Puget Sound. Est. $650,000 submitted. **04,** 9.

1904–05. Est. $500,000 submitted. **05,** 10.

1905–06. Est. $3,310,500 submitted. **06,** 8.

1906–07. Est. $3,478,500 submitted. **07,** 8.

1907–08. Constr. of wall at Boston by city in progress. Tract at Fort Armistead, Md., purchased. Est. $250,000 submitted. **08,** 13.

1908–09. R. on defense of San Pedro, Cal., submitted. Est. $400,000 inadequate. **09,** 14.

1909–10. Acquisition of land for San Pedro completed. **10,** 15.

1910–11. Est. $150,000 for acquisition of land at Cape Henry. **11,** 11; **12,** 10.

Part 2, FMG. Defenses of Insular Possessions.

1902–03. Imp. of providing for defenses of insular possessions. Est. $2,000,000 for constr. gun and mortar batteries. Est. $526,100 for land for sites. **03,** 14.

1903–04. Preparation of pre. projs., accurate surs. of sites completed. Funds applied in the Philippines. Negotiations under way for acquisition of land. **04,** 10.

1904–05. Installation of batteries for the defense of important naval station at Guantanamo B., Cuba. Important that remaining sites be obtained as soon as possible. **05,** 12.

1905–06. Act 1906 provided for batteries in the Hawaiian Islds. **06,** 10.

1906–07. Est. for next year, $8,618,000. **07,** 11.

1905–06. Est. $526,100 submitted for acquisition of sites in the Hawaiian Islds. **06,** 11.

1907–08. Suggest condemnation proceedings. **08,** 17.

1907–08. Est. $2,818,400. **08,** 16.

1908–09. Condemnation proceedings instituted; court decree rendered. **09,** 18; **10,** 21; **11,** 21; **12,** 19.

1908–09. Batteries have been constr. at Guantanamo B., Cuba, and constr. work now in progress at Honolulu and Pearl H., Hawaii, and Manila and Subic B., P. I. **09,** 17.

1909–10. Est. $262,200 (reduced to $150,000) for Hawaiian Islds., and $1,160,000 for Philippines for completion of projs. **10,** 19; **11,** 19; **12,** 18.

1910–11. For constr. of works of defense against landing parties in the Philippine Islds., app. as follows: Act Mar. 4, 1911, $180,000. **11,** 22; **12,** 20.

Part 3, FMG. Dynamite Batteries.

1900–01. Work on battery at Sandy Hook completed; that at Fishers Isld. begun. On June 5, 1901, Board of Ordnance and Fortifications reported this type of battery obsolete. Sec. of War ordered discontinuance of work at Fishers Isld. and Port Royal. **01, 10.**

1901–02. Sec. of War directed sale of obsolete dynamite guns. No further reports to be submitted. **02, 11.**

Part 4, FMG. Modernizing the Older Emplacements.

1903–06. Proposed to bring older emplacements, first constr. under Endicott plan, up to date. Est. $942,500 for 1,297 different emplacements. **04, 8; 05, 9; 06, 7.**

1906–12. Au. asked to apply $165,261.36 to the initiation of mechanical powder service. **07, 8.** Au. granted· arrangements for manufacture and installation of machines in progress. **08, 12; 09, 12; 10, 14; 11, 8; 12, 8.**

FMH. SUPPLIES.

(See FMA. p. 1801 of this Index.)

Part.	Title.
1	Supplies for coast defense.
2	Supplies for coast defense, insular.
3	Equipment of Coast Artillery, armories, Organized Militia.

Part 1, FMH. Supplies for Seacoast Defenses.

1900–01. Requisitions are made directly upon Chief of Engineers for tolls and electrical and engine supplies for use of troops for maintaining light and power plants in gun and mortar batteries. Est. $25,000 submitted for next year. **01,** 11.

1901–03. Est. $35,000 submitted. **02,** 12; **03,** 12.

1903–08. Est. $40,000. **04,** 10; **05,** 11; **06,** 9; **07,** 10.

1907–08. Wattmeters being procured. As plants become worn, demands for supplies increase. $45,000 est. necessary for procurement of electrical supplies. In addition, issue of reserve electric lights of a form approv. after exhaustive test by the Artillery requested by Chief of Coast Artillery; believed desirable by Chief of Engineers; est. $19,500 additional to the $45,000 above. **08,** 15.

1908–12. Est. $45,000 submitted for 1910. **09,** 16; **10,** 17; **11,** 12; **12,** 11.

Part 2, FMH. Supplies for Seacoast Defenses, Insular Possessions.

1908–12. Est. $5,000 submitted for necessary supplies and material for plants in Philippine Islds., $1,000 for Hawaiian Islds. **09,** 19; **10,** 20; **11,** 22; **12,** 20.

Part 2, FMH. Equipment of Coast Artillery, Armories, Organized Militia.

The Army app. act approv. Mar. 3, 1911, provided the sum of $338,170 for the equipment of armory buildings provided by States for instructional purposes for Coast Artillery companies of the Organized Militia. With these funds equipments are being installed for the instruction of Coast Artillery militia at the following places:

Boston, Mass., South Armory.
Bridgeport, Conn.
New York City:
  Ninth District Armory.
  Thirteenth District Armory.
Savannah, Ga.
San Francisco, Cal.

For the work required of the Engineer Department in this connection the sum of $105,426.56 has been assigned to this department for expenditure by the Sec. of War. At the close of the fiscal year the engineer work at the Boston Armory had been completed so far as possible pending the arrival of the armament and other equipment, and the work remaining to be done at this armory and the necessary work at the other armories had been placed under contract.

By the Army app. act of Aug. 24, 1912, the availability of this app. was extended to include obligations incurred during the fiscal year ending June 30, 1913.

12, 29.

FMI. TORPEDOES, MINES, ETC.

(See FMA. p. 1801 of this Index.)

Part.	Title.
1	Submarine mines.
2	Submarine mines, insular.

Part 1, FMI. Submarine Mines.

1900–01. With few exceptions all Hs. equipped with torpedo storehouses, cable tanks, mining casemates. Experiments have been conducted. Est. $100,000 made for continuing work. Work of transferring torpedo equipment to Artillery in progress under act Feb. 2, 1901. **01,** 12.

1901–02. Mining casemates and additional storage facilities required at several localities. Est. $100,000 submitted. Act June 6, 1902, assigned to Artillery Corps purchase of torpedo material proper, such as cables, cases, floating plant, etc., and left the constr. of buildings, casemates, cable galleries, and cable tanks with the Corps of Engineers. **02,** 13.

1902–03. Est. $225,000 for additional material. **03,** 13.

1903–04. Based on a list of new casemates, cable tanks, storehouses, and loading rooms prepared by Artillery board. Au. est. $600,000 submitted. All apparatus has now been transferred to Artillery. **04,** 10.

1904–05. Est. $540,700 submitted. **05,** 12.

1905–06. Est. $1,352,819 submitted. **06,** 10.

1906–07. Est. $464,964 submitted. **07,** 11.

1907–08. Est. $289,964 submitted. **08,** 16.

1908–09. Est. $189,964 (omitted). **09,** 17. Reduced to $50,000. **10,** 19; **11,** 15.

1911–12. Est. $35,000 submitted. **12,** 14.

Part 2, FMI. Submarine Mines, Insular Possessions.

1905–07. Est. $382,500 submitted for constr. torpedo structures. $24,000 for Guantanamo B., Cuba; $221,000 for Manila, P. I.; and $137,500 for Subic B., P. I. **06,** 11; **07,** 12.

1907–08. Detailed plans being prepared. **08,** 17; **09,** 18; **10,** 20; **11,** 22; **12,** 20.

FMJ. SEA WALLS AND EMBANKMENTS.

(See FMA. p. 1801 of this Index.)

1900–01. General constr. of sea walls and embankments. Work at Fort Schuyler, N. Y., Fort Monroe, Va., Fort Smallwood, Md., and Gardiners Point, N. Y., completed during year. Storm tide damaged reservation and provisions made for sea wall and filling in at Fort Caswell, N. C. At close of year concrete wall completed, contract for fill behind wall let. App. of Mar. 1, 1901, applied to work at entrance to Long Island Sound, N. Y. H., Narragansett B., Baltimore, Md., Hampton Roads, Va., and New Orleans, La. Est. $150,000 submitted. **01**, 11, 12.

1901–02. Filling in at Fort Caswell, N. C., completed. App. of June 6, 1902, applied to constr. of sea walls at entrance to Long Island Sound, N. Y. H., Hampton Roads, Va., Tampa, Fla., Mobile, Ala., and San Diego, Cal. Est. $160,000. **02**, 13.

1902–03. Est. $200,000. **03** 13.

1903–04. Work at Delaware R., Baltimore Md., Cape Fear, N. C., Charleston, S. C., Tampa, Fla., Pensacola, Fla., Mobile, Ala., and New Orleans, La. Est. $300,000 submitted. **04**, 10.

1904–05. Est. $215,900 submitted. **05**, 11.

1905–06. Est. $236,315 submitted. **06**, 9.

1906–07. Est. $180,000 submitted. **07**, 10.

1907–08. Est. $145,914 submitted. **08**, 15.

1908–09. Est. $164,775 submitted. **09**, 16.

1909–10. Est. $142,525 submitted. **10**, 17.

1910–11. Est. $25,000 submitted. **11**, 13.

1911–12. Est. $30,000 submitted. **12**, 11.

FORTIFICATIONS.

SECTION II.—INDEX TO DATA COVERING SPECIAL WORKS.

(See list of works on p. 1796 of this Index.)

FNA. MAINE COAST FORTIFICATIONS.

(NOTE.—Reports on these works from 1903 to 1912 are of a general character only. See the first 15 pages of each annual report from 1903 to 1912.)

Part.	Title.	Period.
1	Contracts	1897-1902
2	Engineering features	....
	Engineers:	
3	Chief of Engineers	1866-1902
4	BE	1882
5	In charge	1866-1902
6	Assistants	1897-1901
7	Civilian electricians	1902
8	Forts, etc.—Operations, allotments, etc	1808-1902
9	Portland H.—Fort Scammel	1808-1901
10	New Fort Preble	1808-1885
11	Fort Gorges (Hog Island Ledge)	1857-1902
12	Site 2—Barbette battery (Portland Head)	1870-1879
13	Barbette battery (Little Hog Island)	1870
14	Cow Island batteries	1879-1885
15	Great Hog Island batteries	1879-1884
16	Site 2—Five emplacements, 10-inch rifles	1893-1902
17	Site 2—Emplacements, 12-inch B. L. rifles	1901-1902
18	Site 1—Mortar battery, Fort Preble	1897-1902
19	Site 3—Emplacements, 12-inch guns (Great Diamond Island)	1897-1902
20	Site 2—Emplacements, 6-inch R. F. guns (Portland Head)	1878-1899
21	Site 2—Emplacements, 6-inch B. L. rifles	1901-1902
22	Site 3—Emplacements, 8-inch guns, disappearing carriages (Great Diamond Island)	1898-1902
23	Site 3—Temporary platforms, 8-inch converted rifles (Great Diamond Island)	1898
24	Site 3—Emplacements, 15-pounder R. F. guns	1899-1902
25	Site 3—Emplacements, 6-inch B. L. rifles, pedestal mounts	1901-1902
26	Site 3—Emplacements, 6-inch R. F. guns	1899-1902
27	Site 3—Mortar battery	1899-1902
28	Site 4—Power house	1902
29	Site 4—Emplacements, 15-pounder R. F. guns	1901-1902
30	Site 5—Emplacements, 15-pounder R. F. guns	1899-1902
31	Site 5—Emplacements, 12-inch B. L. rifles, disappearing carriages	1899-1902
32	Site 5—Emplacements, 10-inch B. L. rifles, disappearing carriages	1899-1902
33	Site 5—Six-inch R. F. guns, pedestal mounts	1902
34	Site 5—Power plant	1902
35	Penobscot River, narrows—Fort Knox, Bucksport	1843-1901
36	Kennebec River, mouth—Fort Popham	1857-1901
37	Bar Harbor, temporary defense	1898-1901
38	Magazines	1902
39	Mounting guns and carriages	1901
40	Preservation and repair	1898-1902
41	Range and position finders	1899-1902
42	Sites	1894-1902
43	Submarine mines	1887-1902
44	Supplies	1900-1902

(See parts 45-62 on p. 1851.)

Part 1, FNA. Contracts.

1897. Two 12-inch emplacements complete, $55,065.20. **97,** 598.

1898. Portland cement, $2.05 and $2.22 per barrel. Sand, 94¢ and $1.20 per c. y. Natural cement, 98¢ per barrel. **98,** 588.

1899. Electric-lighting plant for 16 mortars, $5,300. Sand, 94¢ per c. y. Portland cement, $2.09 per barrel. Rosendale cement, 90¢ per barrel. **99,** 681, 688.

1900. Portland "Vulcanite" cement, $2.35 per barrel; "Atlas," $2.20 and $2.50 per barrel. Rosendale "Brooklyn Bridge" cement, $1.10 and $1.13⅜ per barrel. **00,** 757.

1901. Switchboards, $1,677; accumulators, $3,700. **01,** 703.

1902. Magazine, $3,895. **02,** 627. Boiler, $6,350; boiler set, $162.50; boiler and feed-pump, $73; generating set, $2,387; misc. apparatus, $1,387; wire, $7,682.50. **02,** 627. Broken stone, $1.45 per ton. **02,** 634. Portland cement, $1.55 barrel. and $1.49 barrel; coal, $4.50, $4.70, $5.40 ton; water, 40¢ per 1,000 gallons; sand, 65¢ ton. **02,** 638.

Part 2, FNA. Engineering Features.

Air spaces, methods of securing ventilation and dryness with. 01, 912.

Ammunition rooms, lining. 02, 623.

Ceilings, of hollow tile. 03, 2372 (pl.).

Cement. Portland cement advisable, because of climate. 01, 911.

Concrete, cost of. 94, 7; 97, 587. Mixing and placing, description and cost. 00, 757, 761, 762. Superiority of wet concrete over dry concrete. 01, 911. Composition, for various walls and masses. 01, 911.

Condensation, remedies. 01, 912.

Dampproofing, methods. 04, 3709.

Drains. Floors. 01, 912.

Forts, casemates. "One of the finest types." 02, 621.

Leakage, stopping, methods. 01, 628, 629; 02, 628; 04, 3710.

Linings (see Leakage), of various materials. 03, 2372, 2373 (pls.).

Materials, cost of. 94, 7; 97, 583, 587; 99, 698; 00, 757. Methods of handling. 00, 758.

Power house, electric. 04, 3710.

Sewers, relaying. 02, 625.

Stairways, improvements. 01, 913.

Stone-crushing plant, description and cost. 00, 757, 759, 765.

Telephones, booths for; details. 03, 2371. Concrete steel. 03, 2372 (pls.).

Walls, hollow tile. 03, 2372 (pls.).

Waterproofing, methods of. 00, 736, 738, 739, 763; 01, 911; 02, 2451.

Part 3, FNA. Engineers.

Chief of Engineers. R., 66, 4; 67, 4; 68, 7; 69, 7; 70, 12; 71, 7; 72, 4; 73, 5; 74, 6; 75, 6; 76, 7; 77, 5; 78, 7; 79, 9; 80, 19; 81, 17; 82, 12; 83, 8; 84, 13; 85, 7; 86, 7; 91, 6; 92, 8; 93, 5; 94, 6; 95, 6, 503; 96, 11, 469; 97, 11, 581; 98, 14, 583; 99, 16, 685; 00, 13, 733; 01, 13; 02, 14.

Part 4, FNA. Board of Engineers.

Constituted, 1882, to consider and report upon the condition of fortifications, and what number, if any, could be dispensed with. R., 82, 414.

Part 5, FNA. Engineers in Charge.

Maj. T. L. Casey, 1866–68.
Lt. Col. G. Thom, 1866–69.
Lt. Col. B. S. Alexander, 1867.
Maj. G. Weitzel, 1867.
Lt. Col. J. C. Duane, 1869–79.
Col. C. E. Blunt, 1879–86.
Maj. J. A. Smith, 1886.
Lt. Col. P. C. Hains, 1893–95.
Lt. Col. D. P. Heap, 1895–96.
Lt. Col. A. N. Damrell, 1896–97.
Maj. R. L. Hoxie, 1897–99.
Maj. S. W. Roessler, 1899–02.

Part 6, FNA. Assistants.

Lt. G. P. Howell, 1897–99.
Capt. C. Keller, 1899–1900.
Lt. T. H. Jackson, 1899–01.
Lt. C. W. Kutz, 1900–01.

Part 7, FNA. Civilian Electricians.

1902. $1,200 allotted for pay of an expert electrician. 02, 633.

Part 8, FNA—

FORTS AND BATTERIES.

Part 9, FNA. Portland Harbor, Me.—Fort Scammel.

1808. Original work—semicircular battery, with brick scarp and blockhouse in rear; a detached lunette northeast of it built. **80,** 15.

1845. The work connected and inclosed with brick scarp and earthen parapet. **80,** 15.

1862. Work on new plans begun. **80,** 15.

1866. Six casemates, second tier of east bastion, completed; the other 7 platforms ready for armament. **66,** 5.

1867. Five embrasures built in scarps of second tier of west bastion; 4 casemates for guns and 1 for flank howitzers completed in east bastion; 2 magazines in gorge nearly finished. **67,** 5.

1868. Work on gorge wall, magazines, and excavation for foundations. **68,** 9.

1869. Magazine traverse C built and drains completed; site for magazine traverse B excavated. **69,** 9.

1870. Modification plans made. Care and preservation. **70,** 13.

1871. $50,000 app. Old building demolished to make way for new work; 6 magazines built and covered with earth; work on great magazine in old work. **71,** 8.

1872. $42,500 app. Stone piers in parade of west bastion built; parados built; communication through traverses of front 4 and the rock excavation for great magazine completed; minor work. **72,** 5.

1873. $50,000 app. Great magazine and concrete arches over parade of east bastion built; work on bombproof of west bastion, embankments of great magazine, and traverses of main work; site prepared for main magazine of new work. **73,** 6.

1874. $30,000 app. Concrete bombproof covering, breast-height walls, and concrete communications of east and west bastions completed; slopes of traverses and parados sodded; and all but one position made ready for platforms. **74,** 7.

1875. $20,000 app. Parapet and bombproof embankments, gun platform and service magazines and stairway communication completed at e. and w. bastions; passages about the great magazine entrance completed; and minor work. **75,** 7.

1876. Sally port extension and second passage to extension in main work built in concrete; 2 gun platforms and all traverse and parados embankments of old part of main work completed, and parade graded. **76,** 8.

1877-79. Care and preservation. **77,** 6; **78,** 8; **79,** 10.

1885. Plans required revision. **85,** 9.

1886. Six magazines put in serviceable order; care and preservation. **86,** 9.

1901. Removing old ordnance. **01,** 699; **02,** 623.

Part 10, FNA. Portland Harbor, Me.—New Fort Preble.

1808. Original work built. **80,** 20.

1863. New work begun. **86,** 9.

1866. Piling of the scarps finished and bed of foundation of front 2 completed; minor work. **66,** 5.

1867. Grillage and capping for foundation of scarps completed; 8 embrasures completed; r. excavation of scarps of old work, and masonry of fronts B and C commenced **67,** 5.

1868. The scarps of old work and earthen parapet nearly finished; stairway from upper to lower parade completed; foundation for magazine traverse, south battery, completed; erecting piers; tearing down quarters; minor work. **68,** 8.

1869. Magazine traverse, south battery, completed; excavation for new magazine in old inclosed work finished; parade partly filled in; minor work. **69,** 8.

1870. Modification plans made; superior slopes of old work completed and sodded; terreplein partly graded; 250 c. y. concrete placed around magazine in old work; parade partly filled in. **70,** 13.

1871. $28,500 app. Traverse magazine and earthwork in gap between north battery and old redoubt finished; traverse magazine in south battery extension finished; minor work. **71,** 8.

1872. $42,500 app. Great magazine and easterly traverse magazine built in old redoubt and embankments built and sodded; breast-height wall of old redoubt built; second new traverse magazine in south battery finished; minor work. **72,** 5.

1873. $40,000 app. Modification of old redoubt finished; last 6 traverse magazines of south battery built, two-thirds work completed; and north battery extension commenced. **73,** 6.

1874. $20,000 app. Two permanent platforms in redoubt, 1 in north battery, and 1 temporary wooden platform in south battery made ready for guns; traverses and parapets of south battery completed; and concrete magazine, parados, bombproof, breast-height walls, part of embankment, and roadway of north battery completed. **74,** 7.

1875. $10,000 app. Six gun platforms and breast-height walls and parapet of 5 bays in south battery completed; pintle bolts set for 4 additional gun platforms; 1 gun platform laid and all embankments completed in north battery. **75,** 7.

1876. Four breast-height walls, 5 gun platforms built in south battery; parapet sodded; and north battery roadway completed. **76,** 8.

1877-79. Care and preservation. **77,** 6; **78,** 7; **79,** 10.

1885. Plans require revision. **85,** 8.

Part 11, FNA. Portland Harbor, Me.—Fort Gorges, Me. (Hog Island Ledge).

1857. Work begun. 80, 20.

1866. Modifying and constructing the gorge; preparing cut stone for stairway towers; minor work. The gun casemates about completed and ready for armament. 66, 4.

1867. Roof surfaces of the gorge completed and same filled with earth to level of terreplein; quarters partly finished; drainage work; reinforcing with granite arches the scarp walls of the gorge magazines; minor work. 67, 4.

1868. Rubble foundations for 2 stairway towers completed; cut-stone masonry of towers 1, 3, and 4 partly completed; scarps of the magazines reinforced; 3 barbette center-pintle gun platforms built, and 2 magazine traverses on the gorge and 4 bombproof traverses built. 68, 8.

1869. Two magazine traverses on the gorge and bombproofs on fronts 1, 4, and 5 of barbette tier completed, and board roof built over them to protect them against the weather. 69, 8.

1871. $15,000 app. Work resumed. The great magazine on front 1, central traverse magazine, new entrance to the easterly traverse magazine, and breast-height walls of front 1 nearly completed; earthwork on front 6 about finished. 71, 8.

1872. $20,000 app. Earthwork of gorge completed and that of front 1 nearly completed; parados and covering of bombproofs begun. 72, 5.

1873. Parados on fronts 2, 3, 4, and 5 completed; some minor work. 73, 6.

1874. Quarters plastered, balcony ironwork completed, and stone and ironwork for barbette-gun platforms in progress. 74, 7.

1875. Seven gun-platform stones raised to the terreplein. 75, 6.

1876. Parade graded; balcony on parade wall built; parade gates iron plated and hung; completion of the flooring and finishing of all the quarters in the gorge. 76, 8.

1877–79. Care and preservation. 77, 6; 78, 7; 79, 9.

1901. All armament either condemned or donated; $600 allotted. 01, 698.

1902. Watchman on duty. 02, 622.

Part 12, FNA. Portland Harbor, Me.—Site No. 2—Barbette Battery (Portland Head).

1870–71. Proj. prepared by BE.; est., $212,676. 70, 13; 71, 9.

1872. $50,000 app. Title to land yet to be perfected. 72, 6.

1873. Preparing for constr., 73, 6.

1874. Work begun, 1873; parapet embankment part filled in, and 4 concrete traverse magazines built. 74, 7.

1875. $20,000 app. Stone for 5 gun platforms prepared. 75, 7.

1876. Work on embankment of parapet and traverses of front 1; 3 breast-height walls, 6 gun platforms, and 2 traverse magazines built; minor work. 76, 8.

1877–79. Care and preservation. 77, 6; 78, 8; 79, 10.

Part 13, FNA. Portland Harbor, Me.—Barbette Battery (Little Hog Island, New Work).

1870. Plans for an irregular hexagonal barbette battery; est., $234,550. 70, 14.

Part 14, FNA. Portland Harbor, Me.—Cow Island Batteries.

1879. Plans for heaviest armor prepared by BE. 79, 10.

1885. Plans require revision. 85, 9.

Part 15, FNA. Portland Harbor, Me.—Great Hog Island Batteries.

1879. Plans prepared by BE. for heaviest armor. 79, 11.

1884. Plans require revision. 84, 10.

Part 16, FNA. Portland Harbor, Me.—Site No. 2—Five Emplacements for 10-inch Rifles (Portland Head).

1893. $110,000 allotted. Work begun in April. 93, 5.

1894. 4,068 c. y. concrete placed in 2 emplacements. 94, 7.

1895. $5,000 allotted. Two emplacements completed, costing $90,261.05; 12,450 c. y. concrete placed; foundation excavated for third emplacement. 95, 6, 503.

1896. Concrete work for third emplacement nearly completed. 96, 469.

1897. $83,000 allotted. Work on battery C finished; 2 carriages and 4 guns on hand. 97, 584.

1898. $21,000 allotted. Batteries B and C nearly completed; all guns mounted. 98, 583.

1899. $200 allotted. Erection of ironwork. 99, 692.

1900. $500 allotted. Six observation stations erected; raising floors in magazines and passageways; ventilators placed in magazines and shell rooms; minor work. 00, 736.

1901. $700 allotted. Speaking tubes bet. platforms and magazines and telephone connection bet. commander's station and telephone booths erected. 01,701.

1902. Work completed; plans prepared for installing chain hoists. 02, 624.

Part 17, FNA. Portland Harbor, Me.—Site No. 2—Emplacements for Two 12-inch B. L. Rifles.

1901. $130,000 allotted. Work begun; excavation practically completed. 01, 701. $34,500 allotted for electric light and power plant; power house and excavation 80% completed. 01, 702.

1902. Excavation, fill, and concrete work completed; post sewer relaid; 2 hydrants placed. 02, 625. $12,500 allotted. Electric power house; installation conduit work completed. 02, 627.

Part 18, FNA. Portland Harbor, Me.—Site No. 1—Mortar Battery (Fort Preble).

1897. $125,000 allotted for battery for sixteen 12-inch mortars. Work begun Nov. 30, 1896; excavation well advanced. 97, 581.

1898. $67,000 allotted. Excavation completed; platforms finished; base rings set and concrete; work of 1 magazine nearly completed; 6,662 c. y. placed. 98, 585.

1899. $14,050 allotted. All platforms completed, base rings set, carriages assembled, and 8 mortars mounted. 99, 687.

1900. $19,000 allotted. All mortars mounted, work nearly completed. 00, 735.

1901. $5,000 allotted. Grading, sodding, floor constr., etc., completed. Shell rooms and magazines lined; floors graded and raised; battery transferred to Artillery. 01, 699.

1902. Lining work completed. 02, 623.

Part 19, FNA. Portland Harbor, Me.—Site No. 3—Two Emplacements for 12-inch Guns (Great Diamond Island).

1897. $70,000 allotted. Battery to be built under contract. $3,200 allotted for contingencies. Work begun in April, 1897. 97, 588.

1898. Excavation nearly finished; 2,908 c. y. concrete placed; progress unsatisfactory; contract annulled July 7, 1898. 98, 589.

1899. $36,890 allotted. Work continued with hired labor; carriages and guns mounted; concreting, setting ironwork, and making drains. 99, 693.

1900. $9,000 transferred from other works. Battery completed, except macadamizing the roadway and erection of hand railing. 00, 739.

1901. Work completed. 01, 705.

1902. $2,500 allotted. Platform hoist ordered and preparation of emplacements commenced. 02, 629.

Part 20, FNA. Portland Harbor, Me.—Site No. 2—Emplacement for 6-inch R. F. Gun (Portland Head).

1898. $8,000 allotted. Work begun in May; platform built, ready for gun. **98, 588.**

1899. Gun mounted and work completed. Cost, $6,545.33. **99, 692.**

Part 21, FNA. Portland Harbor, Me.—Site No. 2—Emplacements for Two 6-inch B. L. Rifles.

1901. $30,000 allotted. Preparation of plans in progress. **01, 703.**

1902. $4,000 allotted. Negotiations for purchase of land in progress. **02, 626.**

Part 22, FNA. Portland Harbor, Me.—Site No. 3—Eight Emplacements for 8-inch Guns on Disappearing Carriages (Great Diamond Island).

1898. $150,000 allotted. Work begun in March. **98, 590.**

1899. $220,000 allotted. Battery A—Three carriages mounted; guns on hand; concreting nearly finished; some asphalt work. Battery B—Both carriages mounted; concreting and asphalting. Battery D—Emplacement 1 nearly completed. **99, 694.**

1900. $17,000 allotted. Battery A—2,722 c. y. concrete placed; ironwork placed; roadway graded. Battery B—Concrete work; ironwork and roadway completed; battery practically completed. Battery D—Concrete ork for 2 emplacements completed; ironwork, platforms, and masonry walls in progress; minor work not finished. **00, 738.**

1901. $12,000 allotted. First battery—Guns mounted; work completed. Second battery—Practically completed; 1 gun mounted; concrete, masonry, and fill work done. **01, 704.**

1902. No. 2 of emplacement 6, loam placed; roadway and slopes graded; gun mounted. Nos. 1 and 3, emplacement 6, fill completed; roadways and slopes graded; trolleys erected etc. **02, 628, 629.**

Part 23, FNA. Portland Harbor, Me.—Site No. 3—Temporary Platforms for Two 8-inch Converted Rifles (Great Diamond Island).

1898. $3,000 allotted. Platforms completed, with magazine, and guns mounted. **98, 590.**

Part 24, FNA. Portland Harbor, Me.—Site No. 3—Two Emplacements for 15-pounder R. F. Guns.

1899. $10,000 allotted. **99, 693.**

1900. Work begun; excavation nearly finished; location shifted 25′ to the front. **00, 740.**

1901. First battery—Gun platforms, floors of magazines and rooms laid. Second battery—$9,103.10 allotted. Excavation completed; plant erected; $478.10 of above for triangulation of Portland H. **01, 707.**

1902. First battery—Battery completed; guns mounted. Second battery—Completed; guns mounted. **02, 631.**

Part 25, FNA. Portland Harbor, Me.—Site No. 3—Emplacements for Two 6-inch B. L. Rifles on Pedestal Mounts.

1901. $25,000 allotted. Plans completed and app.; no field work begun. **01, 708.**

1902. $3,900 allotted. Work commenced; excavation made; plant erected; floors, platforms, etc., laid. **02, 632.**

Part 26, FNA. Portland Harbor, Me.—Site No. 3—Two Emplacements for 6-inch R. F. Guns.

1899. $56,000 allotted. **99, 693.**

1900. Work begun; excavation for site completed, and foundation walls of rubble masonry of 1 emplacement laid. **00, 740.**

1901. Concrete portion emplacement completed; masonry of others brought to ceiling level; 1 carriage on hand; 3,386 c. y. concrete work done. **01, 706.**

1902. Concrete, sand, and loam placed; windows hung; hoists erected; both guns mounted. **02, 630.**

Part 27, FNA. Portland Harbor, Me.—Site No. 3—Mortar Battery.

1899. $125,000 allotted for battery for eight 12-inch mortars; site cleared, and main drain nearly completed. **99, 693.**

1900. Drainage completed; 1,301 c. y. concrete placed in traverses and magazine walls; 6,909 c. y. earth excavated; 7,671 c. y. ledge excavated; and 1,128 c. y. filling; 6 carriages received. **00, 740.**

1901. $21,000 allotted. Eastern and middle traverses completed; 8 mortar carriages assembled; floors laid; excavation and concrete work done. **01, 706.**

1902. Concrete and fill work done; 4 mortars mounted. **02, 630.**

Part 28, FNA. Portland Harbor, Me.—Site No. 4—Power House.

1902. $8,100 allotted. Work commenced; 1,077 c. y. earth and ledge removed; preparation of sites completed; laying concrete foundations begun. **02, 633.**

Part 29, FNA. Portland Harbor, Me.—Site No. 4—Three Emplacements for 15-pounder R. F. Guns.

1901. Plans for battery completed. **01, 708.**

1902. $18,000 allotted. Wharf built; plant erected; excavation completed; drains laid, etc. **02, 633.**

Part 30, FNA. Portland Harbor, Me.—Site No. 5—Three Emplacements for 15-pounder R. F. Guns.

1899. $12,000 allotted. **99, 699.**

1900. Work begun 1899; r. excavation completed; all floors constr., drainpipes laid, and concreting commenced. **00, 763.**

1901. $2,000 allotted. Battery completed. **01, 710, 711.**

1902. Guns mounted. **02, 635.**

Part 31, FNA. Portland Harbor, Me.—Site No. 5—Three Emplacements for 12-inch B. L. Rifles on Disappearing Carriages.

1899. $162,000 allotted. Site cleared for emplacements 3 and 4; 5,745 c. y. earth and 12,597 c. y. r. excavated. **99, 699, 700.**

1900. $17,000 allotted. Excavation or emplacements 3 and 4; drains and roadway completed; 1,982 c. y. concrete placed and drainpipe laid; waterproofing with Neuchatel-rock asphalt; excavation and drainage for emplacement 2 nearly completed. **00, 762, 763.**

1901. $10,000 allotted for emplacements 3 and 4. Emplacement 4 completed; carriages assembled and gun mounted. Emplacement 3 nearly completed. $10,500 allotted for emplacement 2; r. excavation, drains, r. fill, and concrete work done. **01, 709.**

1902. (Emplacements mentioned as Nos. 1, 2, and 3 in 1902.) Concrete and sand fill placed in No. 2, trolley rails and ammunition hoists erected. At emplacement 1 masonry and fill work done, and asphalt waterproofing laid. Emplacement 1 nearly completed, except receiving carriage and mounting guns. **02, 634**

Part 32, FNA. Portland Harbor, Me.—Site No. 5—Two Emplacements for 10-inch B. L. Rifles on Disappearing Carriages.

1899. $92,000 allotted. Excavation for emplacements and drains completed; 18,294 c. y. removed; artesian well under constr. **99,** 699.

1900. $26,000 allotted. 2,435 c. y. concrete placed and all floors completed. **00,** 763.

1901. Carriages assembled and guns on trunnions; concrete, asphalt, and sand work done. **01,** 710.

1902. $1,000 allotted. 1,692 c. y. fill placed; 100 c. y. concrete laid; guns painted and cleaned. **02,** 635.

Part 33, FNA. Portland Harbor, Me.—Site No. 5—"Four" 6-inch R. F. Guns on Pedestal Mounts.

1902. $55,000 allotted. Work begun, derricks erected, tracks extended, excavations, etc. Half of battery completed to floor level. **02,** 635.

Part 34, FNA. Portland Harbor, Me.—Site No. 5—Power House and Electric Plant.

1902. $1,000 allotted. Conduit and manholes constr. **02,** 636.

Part 35, FNA. Penobscot River, Narrows of—Fort Knox, Bucksport, Me.

1843. Work begun. **80,** 19.

1866. Three-gun battery of the southeast place-of-arms nearly completed; covered communication with battery B finished; northeast demibastion, howitzer casemate, and defensive gallery built; and 3 positions for center pintle 15-inch guns in batteries A and B made ready for armament. **66,** 4.

1867. North covered way, northeast demibastion, and defensive gallery, together with the closure wall and single caponniere of the north ditch, completed; minor work. **67,** 4.

1868. Masonry and subdrainage of the storage casemates under the parade of main work completed; mounting guns on batteries A and B; finishing parapet and terrepleins of 15-inch guns; minor work. **68,** 7.

1869. Exterior slope of the north covered way rebuilt to 8′ below the interior crest; and northern and western exterior slopes of the northeast place-of-arms repaired. **69,** 8

1871-84. Care and preservation. **71,** 7; **72,** 4; **73,** 5; **74,** 7; **75,** 6; **76,** 7; **77,** 5; **78,** 7; **79,** 9; **80,** 19; **81,** 17; **82,** 12; **83,** 8; **84,** 13.

1885. Six magazine floors renewed, outside buildings repaired; minor work. **85,** 7.

1886. Parade graded, care and preservation. **86,** 8.

1898. $150 allotted. Proj. for change in position of old platforms and addition of modern guns; minor repairs of old works. **98,** 583.

1899. $600 allotted. Minor repairs of armament of old works. **99,** 686.

1900. Storeroom repaired; minor repair of quarters. **00,** 733.

1901. Repairs and removing débris; buildings sold. Plans and est. for 2 emplacements for 6-inch R. F. guns called for. **01,** 697.

Part 36, FNA. Kennebec River, Mouth of—Fort Popham, Me.

1857. Casemated work; work begun. **80,** 19.

1866. Scarps of the gun fronts and bastions brought to within 2 courses of the cordon line; all gun embrasures of the second tier of fire completed; second-story magazines nearly finished, and 5 second-tier casemates covered with bombproof arches. **66,** 4.

1867. Scarps of the gun fronts and bastions brought to level of the cordon line; second-tier casemates along this front completed; minor work. **67,** 4.

1868. Concreting arches of gun casemates 24 to 37, inclusive; laying concrete floors of 3 magazines on terreplein of water fronts; minor work. **68,** 8.

1869. Board roof built over unfinished casemates; care and preservation. **69,** 8.

1870–72. Care and preservation. **70,** 13; **71,** 8; **72,** 5.

1873. Proj. for completion of fort, and constr. of a contiguous exterior battery for 4 guns approv. in 1872. **73,** 5.

1874–86. Care and preservation. **74,** 7; **75,** 6; **76,** 7; **77,** 5; **78,** 7; **79,** 9; **80,** 20; **81,** 17: **82,** 13; **83,** 8; **84,** 14; **85,** 8; **86,** 8.

1898. Work modified to meet modern requirements as to cover. No work under proj. $9,030 allotted; temporary wooden platforms for 15-inch guns built, and guns mounted; emplacement for one 8-inch B. L. rifle on strengthened 15-inch S. B. gun finished and carriage mounted; minor work. **98,** 584.

1899. $2,800 allotted. Work on temporary platforms for four 15-inch guns; emplacement for 8-inch rifle finished. **99,** 686.

1900. $1,500 allotted. Four 15-inch S. B. guns dismounted and stored; platforms taken up, and ground leveled. **00,** 733.

1901. Repairs, slopes, and retaining walls of emplacement for one 18-inch B. L. rifle practically rebuilt. Plans and est. for 2 emplacements 6-inch R. F. guns on pedestal mounts called for. **01,** 698.

Part 37, FNA. Bar Harbor, Me., Temporary Defense.

1898. $6,000 allotted. Proj. for two 8-inch converted rifles and two 10-inch S. B. guns mounted on temporary wooden platforms; consent of owners of sites secured; materials, guns, and carriages received in May. **98,** 591.

1899. $1,000 transferred from other allotments. Both 8-inch rifles mounted; 1 magazine finished; mounting two 10-inch S. B. guns and building magazines. Ordered to suspend work. **99,** 685.

1901. Two 10-inch guns condemned and sold;. two 8-inch converted rifles moved to nearest reservation; ordnance stores to be sent to Watertown **01,** 697; **02,** 621.

Part 38, FNA. Magazines.

1902. $5,000 allotted for Peace Storage Magazine; building erected. **02,** 626.

Part 39, FNA. Mounting Guns and Carriages.

1901. Table showing cost of handling, caring for, and mounting guns and carriages, site 5, Portland. **01,** 711, 712.

Part 40, FNA. Preservation and Repair of Fortifications.

1898. $50 allotted for Fort Gorges; repairing scarp wall. **98,** 584. Minor work at Fort Preble. **98,** 585. $550 allotted for mounting two 15-inch S. B. guns at Fort Scammel. **98,** 587.

1899. Minor repairs at Fort Preble. **99,** 687. $600 allotted for minor repairs of old works. **99,** 702. $750 allotted for minor repairs at mining casemate. **99,** 703.

1900. $800 allotted for repairing quarters at Fort Gorges. **00,** 734. $1,400 allotted for site 1; floors in magazines and shell rooms repaired. **00,** 735. $12,000 allotted for repairing floors, waterproofing experiment, and minor work at site 2. **00,** 736 $700 allotted for torpedo material at site 4. **00,** 768.

1901. $1,600 allotted for repair of slopes and loaming and seeding, Portland, site 1. **01,** 700, 701. $1,000 allotted for site 2, Portland. **01,** 703.

1902. $1,500 allotted for repair, site 1, Portland. **02,** 623.

Part 41, FNA. Range and Position Finders.

1899. $9,000 allotted. Drawings made. **99,** 702.

1900. Six observation stations erected. **00** 736.

1901. $4,600 allotted for battery commander's station, Portland, site 1; work completed. **01,** 700; **02,** 624. $4,000 allotted. Portland, sites 1 and 3, station au. and plans approv.; site 1 completed; excavation for 5 stations at site 3 completed. **01,** 712. $100 allotted for 2 temporary stations, site 4, for Lewis type A instrument, and 1 at site 1 for base-end instrument; former completed and latter to be constr. **01,** 712, 713.

1902. $2,500 allotted fire commander's station, site 2, Portland; excavation completed and walls constr. **02,** 626. Constr. commenced at 2 sites, battery commander's stations; buildings completed; grading done; $1,000 withdrawn. **02,** 636 $2,700 allotted fire commander's station; building commenced and constr. during year. **02,** 637. Necessary work for temporary station completed. **02,** 637.

Part 42, FNA. Sites.

Cushings Island, Me. Site, about 33.4 acres, acquired by condemnation proceedings, $112,423.60. **94,** 13.

Battery for sixteen 12-inch mortars. Site purchased for $13,202.50. **97,** 12.

1902. Kennebec R., Me. $10,050 allotted. Site purchased. **02,** 622.

Part 43, FNA. Submarine Mines.

1887. Three casemates proposed, with est. of cost. **87,** 11.

1891. Proj. for additional casemate. **91,** 6.

1892. One casemate nearly completed. **92,** 8.

1893. One casemate completed; cost, $8,979.75; work on 2 more begun. **93,** 5.

1894. Work on 2 casemates. **94,** 7.

1895. Two casemates completed in October, 1894; cost, $17,968.92. **95,** 6.

1898. Cable storage tank at Fort Preble completed; cost, $2,206.53. $4,500 allotted, 1897, for torpedo storehouse at Fort Gorges; nearly completed. **98,** 584, 585. $23,300 allotted for torpedo defense—mines placed in the three channels leading into Portland H., and also in the Kennebec and Penobscot Rs.; 6 casemates equipped. **98,** 592.

1899. $350 allotted. Small storehouse built; minor work. **99,** 686, 702. $9,000 allotted—mines removed from H. and Rs., cleaned and stored (explosives utilized in connection with r. excavation for fortifications). **99,** 708. $1,200 allotted for searchlight supplies; no funds necessary. **99,** 709.

1900. Torpedo material overhauled and cleaned. **00,** 768.

1901. $3,000 allotted. Penobscot R., brick storehouse for masonry material built. **01,** 697. Stored material overhauled and cleaned. **01,** 698. $9.78 allotted for sixteen 12-inch B. L. mortars, site 1, Portland. **01,** 700. $5,000 allotted, Portland, site 2, plans completed for mining casemates. **01,** 703. $5,500 allotted, site 3, Portland, mining casemate No. 1; excavation completed. $4,500 allotted, site 3, Portland, mining casemate No. 2. **01,** 708. $150 allotted for overhauling and cleaning. $2.01 for minor expenses. **01,** 713.

1902. Portland, site 2, work on casemates begun and practically completed. **02,** 628. Portland, site 3, casemates practically completed. **02,** 632. Material overhauled and cleaned. **02,** 637.

Part 44, FNA. Supplies for Coast Defenses.

1900. $600 allotted for filling requisitions by post commanders for material to be supplied by the Engineer Department. **00,** 768. Supplies furnished commanders. **01,** 713; **02,** 637.

FNA. PORTSMOUTH (N. H.) FORTIFICATIONS.

(See parts 1–44 on p. 1841.)

Part.	Title.	Period.
45	Contracts	1897–1902
46	Engineering features	....
47	Engineers—Chief of Engineers	1866–1902
48	B E	1882
49	In charge	1866–1902
50	Assistants	1897–1901
51	Forts, etc.—Operations, allotments, etc	1863–1902
52	Fort McClary (Kittery Point, Me.)	1863–1901
53	Fort Constitution	1866–1901
54	Barbette battery (Gerrish Island, Me.)	1872–1884
55	Barbette battery (Jerrys Point)	1872–1886
56	Two 8-inch gun emplacements	1897–1902
57	Two 8-inch B. L. R. guns, on strengthened barbette carriages for 15-inch S. B. guns	1898–1900
58	Three emplacements, 10-inch guns, disappearing carriages	1899–1902
59	Emplacements, two 12-inch guns, disappearing carriages	1901–1902
60	Preservation and repairs	....
61	Sites	....
62	Submarine mines	1897–1902

Part 45, FNA. Contracts.

1897. Two 8-inch gun emplacements, $55,-372.52. 97, 599.

1900. Portland "Atlas" cement, $2.24 barrel. 00, 769.

1901. "Atlas" Portland cement. 01, 715.

1902. Tile, $157.50 and $210 per M; steel doors, 2 x 6″, $27; 3′, $30; 4′, $40; 6′, $54; Saylor's Portland cement, $1.40 barrel in sacks; broken stone, $1.85 c. y.; sand, 67¢ c. y. 02, 641.

Part 46, FNA. Engineering Features.

Cement—tests. 02, 2455. Mixing. 02, 2454.

Concrete—mixing and placing. 00, 770; 02, 2453 (pl.). Superiority of dust over sand. 02, 2457. Strength of various mixtures. 02, 2454.

Construction plant, details. 02, 2452 (pl.).

Doors—ammunition hoist. 05, 3006 (pls.).

Drainage. 02, 2454.

Employees—distribution of. 00, 772.

Leakage—preventing. 05, 3003, 3004, 3006 (pls.).

Linings. 03, 2380 (pls.).

Magazines—stanchions. 05, 3006 (pls.).

Pavements—waterproofing 05, 3006.

Plant—cost of. 00, 772.

Rocks. 05, 3006 (pls.).

Roofs—concrete blocks in. 05, 3006 (pl.).

Ventilation—various methods employed. 05, 3005, 3006 (pls.).

Waterproofing—methods employed. 03, 2374, 2380; 04, 3711; 05, 3003, 3006.

Part 47, FNA. Engineers.

Chief of Engineers. R., 66, 5; 67, 5; 68, 9; 69, 9; 70, 14; 71, 9; 72, 6; 73, 6; 74, 8; 75, 7; 76, 8; 77, 6; 78, 8; 79, 11; 80, 21; 81, 19; 82, 14; 83, 10; 84, 16; 85, 10; 86, 10; 94, 13; 95, 6; 96; 12; 97, 12, 597; 98, 15, 591; 99, 17, 708; 00, 14, 768; 01, 15; 02, 15.

Part 48, FNA. Board of Engineers.

Constituted, 1882, to consider and report upon the condition of fortifications, and what number, if any, could be dispensed with. R., 82, 416.

Part 49, FNA. Engineers in Charge.

Lt. Col. J. N. Macomb, 1866.
Lt. Col. Z. B. Tower, 1867.
Lt. Col. J. G. Foster, 1867-71.
Lt. Col. J. C. Duane, 1871-79.
Col. C. E. Blunt, 1879-86.
Maj. J. A. Smith, 1886.
Lt. Col. A. N. Damrell, 1897.
Maj. R. L. Hoxie, 1897-99.
Maj. S. W. Roessler, 1899-1900.
Maj. W. L. Fisk, 1900.
Capt. H. Taylor, 1900-02.

Part 50, FNA. Assistants.

Lt. G. P. Howell, 1897-99.
Lt. C. Keller, 1899.
Lt. T. H. Jackson, 1899-1900.
Capt. C. Keller, 1900.
W. F. Robinson, 1901.
C. F. Woodbury, 1901.
Lt. R. R. Raymond, 1901.

Part 51, FNA—

FORTS AND BATTERIES.

Part 52, FNA. Fort McClary (Kittery Point, Me.).

1863. Original work begun early in century; inclosed barbette work begun in 1863. **80,** 21.

1866. 147 l. f. coping laid on south, southeast, and east walls; work on west scarp; terreplein excavated. **66,** 5.

1867. Work on scarp wall; ditch excavation. **67,** 5.

1868. Excavation for ditches completed; work on scarp on west front and northwest caponniere; minor work. **68,** 9.

1869-73. Care and preservation. **69,** 9; **70,** 14; **71,** 9; **72,** 6; **73,** 6.

1874. Three temporary wooden platforms for heavy guns nearly completed. **74,** 8.

1875. Roadway repaired. **75,** 7.

1876-86. Care and preservation. **76,** 8; **77,** 6; **78,** 8; **79,** 11; **80,** 21; **81,** 19; **82,** 15; **83,** 10; **84,** 16; **85,** 10; **86,** 10.

1898. $2,400 allotted for preservation and repairs. Three 15-inch guns mounted on temporary wooden platforms. **98,** 587.

1899. Proj. contemplates the use of the existing armament and the mounting of the 15-inch guns pending constr. of modern batteries. **99,** 708.

1900. Repairing engine house to store mining material. **00,** 773.

1901. Care and preservation. **01,** 716.

Part 53, FNA. Fort Constitution.

1866. Work on north scarp; eastern part of old fort demolished and débris removed; foundation of new work in progress. South front, 1 pier and 6 embrasures built and flagging laid for 9 casemates. **66,** 5.

1867. Work on scarp wall; constr. embrasures, and laying flagging. **67,** 5.

1868-71. Care and preservation. **68,** 9; **69,** 9; **70,** 14; **71,** 9.

1872. Earthern barbette battery for 14 guns in rear of the partially casemated work; est., $83,500. **72,** 6.

1874. Temporary position for 2 heavy gun prepared, and platform partly laid. **74,** 8.

1875-86. Care and preservation. **75,** 7; **76,** 9; **77,** 6; **78,** 8; **79,** 11; **80,** 22; **81,** 19; **82,** 15; **83,** 10; **84,** 16; **85,** 10; **86,** 11.

1900. Old building removed; imp. ventilation of magazines. **00,** 773.

1901. $345 allotted for care and preservation. **01,** 717.

Part 54, FNA. Barbette Battery at Gerrish Island, Me.

1872. Proj., 12-gun battery; est., $45,240. **72, 6.**

1873. $25,000 app. Parapet embankment; building concrete magazines. **73, 7.**

1874. $15,000 app. Work on parapet, roadway in rear of terrepleins and 2 traverse magazines. **74, 8.**

1875. $10,000 app. Foundations for all traverse magazines prepared. **75, 8.**

1876. Five breast-height walls finished; gun platforms built. **76, 9.**

1877-78. Care and preservation. **77, 6; 78, 8.**

1879. Plans for completion approv.; partly executed. **79, 11.**

1884. Plans require revision. **84, 16.**

Part 55, FNA. Barbette Battery at Jerrys Point.

1872. Proj., 12-gun battery; est., $46,824. **72, 6.**

1873. $25,000 app. Work begun, parapet embankment and building concrete magazines. **73, 7.**

1874. $15,000 app. Raising parapet embankment; excavation for foundations of all traverse magazines completed. **74, 8.**

1875. $10,000 app. Traverse magazines built; 3 breast-height walls completed; work on parapet embankment. **75, 8.**

1876. Two traverse magazines built, foundation of another laid, and over 2,000 c. y. of embankment made. **76, 9.**

1877-78. Care and preservation. **77, 7; 78, 8.**

1879. Plans for completion approv.; partly executed. **79, 11.**

1884. Plans require revision. **84, 17.**

1885. Placing woodwork in traverse magazines to make them serviceable. **85, 10.**

1886. Platforms ready for 15-inch guns; earthwork incomplete. **86, 11.**

Part 56, FNA. Two 8-inch Gun Emplacements.

1897. $53,150 allotted. Emplacements to be built by contract ($55,372.52). Excavations in progress. **97, 597.**

1898. $800 allotted for repair of buildings Guns mounted; work nearly completed. **98, 591.**

1899. $16,000 allotted. Battery completed under contract; cost, $61,936.21. $500 allotted for repairs of road and buildings. **99, 703.**

1902. Floors relaid, concrete surfaces coated and painted. **02, 639, 640.**

Part 57, FNA. Two 8-inch B. L. R. Guns Mounted on Strengthened Barbette Carriages for 15-inch S. B. Guns.

1898. $6,000 allotted. Work begun; carriages received and mounted, awaiting guns. **98, 592.**

1899. Guns mounted. **99, 708.**

1900. Guns dismounted and shipped elsewhere. **00, 15.**

Part 58, FNA. Three Emplacements for 10-inch Guns on Disappearing Carriages.

1899. $146,000 allotted. Work begun; excavation in progress. **99, 704.**

1900. Excavations completed; concrete floors and parapet of 1 emplacement completed to height of loading platform, and floors of second emplacement completed; 3 carriages received. **00, 769.**

1901. $12,000 allotted. Concrete work completed; erection of ironwork, beams, etc., done; gun carriages mounted; battery practically completed; two 10-inch rifles received. **01, 715.**

1902. Work completed; battery transferred to Artillery. **02, 639.**

Part 59, FNA. Emplacements for Two 12-inch Guns.

1901. $2,000 allotted. Artesian well dug; plans and est. for battery submitted. **01,** 715, 716.

1902. $107,000 allotted. Plant installed; battery excavation completed; wall foundations put in; frame for concrete forms practically completed. **02,** 639.

Part 60, FNA. Preservation and Repair of Fortifications.

The following allotments were made: Fort McClary, $238.58; Fort Constitution, $6.25; Portsmouth, $320.70. Shipping material to depot and minor repairs. **02,** 640.

Part 61, FNA. Sites.

Fort McClary Reservation, Me. By act of Jan. 23, 1893, part of the reservation exchanged for other land; sites transferred by deed. **94,** 12; **95,** 4.

Part 62, FNA. Submarine Mines.

1897. $1,000 allotted. **97,** 598.

1898. $23,300 allotted in connection with defense of Maine coast; placing mines in H. **98,** 592.

1899. $5,633.60 allotted. Mining casemate completed. **99,** 703. Mines removed from H. **99,** 709.

1900. $2,800 allotted for cable tank, which was completed; traveling crane installed; overhauling searchlight plant. **00,** 773.

1901. $300 allotted. Gutters placed and cistern built under torpedo storehouse for cable tank. **01,** 716. $5,700 allotted for torpedo storehouse; building practically completed. **01,** 716.

1902. Crane installed and building for torpedo warehouse entirely completed. **02,** 640. Cable tank entirely completed; pump installed; turned over to Artillery. **02,** 640.

FNB BOSTON (MASS.) FORTIFICATIONS.

(NOTE.—Reports on these works from 1903 to 1912 are of a general character only. See the first 15 pages of each annual report from 1903 to 1912.)

Part.	Title.	Period.
1	Contracts	1901
2	Engineering features	
3	Engineers—Chief of Engineers	1866–1902
4	BE	1882
5	In charge	1866–1902
6	Assistants	1891–1900
7	Forts and batteries—Operations, etc	1833–1902
8	Fort Warren (Georges Isld.)	1833–1887
9	Fort Independence (Castle Isld.)	1833–1899
10	Provincetown H.—Permanent forts	1866–1870
11	Long Isld. Head Battery	1869–1887
12	Fort Sewell (Marblehead)	1884
13	Fort Andrew (Plymouth H.)	1884
14	Fort Standish (Plymouth H.)	1884
15	Fort Winthrop and batteries (Governors Isld.)	1844–1886
16	Emplacements for 8-inch guns, disappearing carriages	1891–1892
17	Site 4.—Mortar battery for sixteen 12-inch mortars	1891–1902
18	Site 5.—Mortar battery for sixteen 12-inch mortars	1897–1902
19	Site 5.—Emplacements, two 6-inch R. F. guns	1901–1902
20	Site 1.—Emplacements, five 10-inch guns, disappearing carriages	1892–1902
21	Site 2.—Emplacements, five 10-inch guns, disappearing carriages	1893–1902
22	Site 1.—Two emplacements, 4-inch R. F. guns	1898–1899
23	Site 2.—Two emplacements, 4.72-inch R. F. guns	1898–1899
24	Site 3.—Three emplacements, 12-inch rifles, disappearing carriages	1898–1902
25	Site 6.—Two emplacements, 12-inch rifles, nondisappearing carriages	1898–1901
26	Site 1.—Two emplacements, 12-inch guns, disappearing carriages	1899–1902
27	Site 1.—Three emplacements, 15-pounder R. F. battery	1899–1900
28	Site 7.—Emplacements, two 6-inch rifles	1901–1902
29	Site 7.—Emplacements, four 10-inch B. L. rifles	1901–1902
30	Site 7.—Three emplacements, 6-inch R. F. guns, disappearing carriages	1899–1902
31	Site 6.—Two 5-inch R. F. guns, pillar mounts	1899–1901
32	Site 2.—Two emplacements, 15-pounder R. F. guns	1900–1901
33	Site 5.—Two emplacements, 5-inch R. F. guns, pedestal mounts	1900–1901
34	Site 7.—Emplacements, three 15-pounder R. F. guns	1900–1902
35	Site 7.—Emplacements, four 15-pounder R. F. guns	1901–1902
36	Miscellaneous—Underground conduit system	1900–1901
37	Central electric lighting plants	1900–1901
38	Construction of lighter	1901–1902
39	Construction of storehouses	1901–1902
40	Roadway at Winthrop	1902
41	Mounting guns and carriages	1900–1901
42	Preservation and repair	1899–1902
43	Range and position finders	1900–1901
44	Sites	1892–1902
45	Submarine mines	1891–1902
46	Supplies for coast defenses	1900–1902

Part 1, FNB. Contracts.

1901. Broken stone, $1.57, $1.75 c. y. **02**, 649. Steam lighter, $19,450; four 6-inch ammunition lifts, $1,638; constr. earth embankment, 60¢ c. y.; tile, $157.50 per M; $210 per M; two 10-inch ammunition hoists, $2,376; excavation and ditching, 55¢ and 85¢ c. y., respectively; steel doors, various size and prices; furnishing employees' meals, 16½¢; Saylor's Portland cement, $1.40 barrel in sacks; sand, 67¢ c. y., 70¢ c. y.; excavating, sodding, etc., various prices listed. **02**, 650, 651.

Part 2, FNB. Engineering Features.

(See also Part 46, FNA, p. 1851.)

Concrete, ingredients of. **00**, 775. Compactness. **01**, 913, 916.

Concrete surfaces, exposed, protection of, during winter months. **99**, 722.

Condensation, overcoming. **01**, 916.

Conduit system, underground, description of. **00**, 776.

Cranes, ammunition. **01**, 913.

Emplacements, cost of. **01**, 914, 916.

Emplacements, liftless. **01**, 916.

Excavations, control of quicksand. **01**, 913.

Plant, central electric lighting, description of. **00**, 777, 779.

Traverses, advantages of. **01**, 916.

Ventilation, securing. **01**, 916.

Waterproofing, description of. **00**, 775, 783.

Part 3, FNB. Engineers.

Chief of Engineers. R., **66**, 5; **67**, 6; **68**, 9; **69**, 9; **70**, 14; **71**, 9; **72**, 6; **73**, 7; **74**, 8; **75**, 8; **76**, 9; **77**, 7; **78**, 8; **79**, 12; **80**, 23; **81**, 20; **82**, 16; **83**, 11; **84**, 17; **85**, 11; **86**, 12; **91**, 6; **92**, 4; **93**, 5; **94**, 7; **95**, 6; **96**, 12, 469; **97**, 12, 600; **98**, 16, 592; **99**, 18, 709; **00**, 15, 773; **01**, 15; **02**, 16.

Part 4, FNB. Board of Engineers.

1882. Constituted to consider and report upon the condition of fortifications, and what number, if any, could be dispensed with. R., **82**, 416.

Est. **87**, 11; **89**, 6; **90**, 5; **91**, 5.

Part 5, FNB. Engineers in Charge.

Maj. C. E. Blunt, 1866.
Col. H. W. Benham, 1866–82.
Maj. F. E. Prime, 1879.
Col. C. E. Blunt, 1883.
Maj. C. W. Raymond, 1883–86.
Lt. Col. G. L. Gillespie, 1886–88.
Col. S. M. Mansfield, 1891–99.
Col. C. R. Suter, 1899–1901.
Capt. Harry Taylor, 1901–02.

Part 6, FNB. Assistants.

Capt. S. S. Leach, 1891–98.
Lt. M. L. Walker, 1897.
Lt. J. S. Sewell, 1897–99.
Lt. R. R. Raymond, 1899–1902.
Lt. C. S. Bromwell, 1899–1900.

Part 7, FNB.—

FORTS AND BATTERIES.

Part 8, FNB. Fort Warren (Georges Island).

1833. Work begun. **80**, 23.

1866. Fort nearly completed according to original plans. Work modifying casemated platforms to suit modern guns of heavy armament; interior finish of casemates for hospital purposes; preparing stone for main gateway; and drainage. **66**, 6.

1867. Fittings of casemates completed; traverse circles with longer radii relaid on parapet of front 1; quarters and hospital finished; and minor work. **67**, 6.

1868. One bombproof traverse on coverface of northeast front 2 built, another one nearly finished; work on scarp wall and arch of main gateway; repairs to drain, slopes, etc.; removal of old engineer buildings within the fort, and their reconstr. **68**, 9.

1869. Masonry and earthwork of bombproof traverse, front 2, completed; repairs to quarters, embankments, and casemates, etc.; modified plans prepared; est. cost, $402,400. **69**, 9.

1870. Repairing leaks in coping of scarp wall, officers' quarters, and renewing asphalt floors, and minor work. **70**, 14.

1871. $50,000 app. Modification work begun; preparing demilune south of main work for larger ordnance; concrete masonry of 2 traverse magazines built; parade walls torn down and drains rebuilt; foundations of all piers for the new, large arches completed; and minor work. **71**, 9.

1872. $85,000 app. Removal of parade wall in bastion A completed; piers of all arches built; stone faces of the arch at the gorge and of arch over stairway completed; work on remaining arches in the bastion, and wing and sustaining wall on right of the gorge; masonry and earth cover of the parados completed; and minor work. **72**, 7.

1873. $40,000 app. All new work in bastion A complete; bastion E masonry of 2 traverse magazines of its barbette completed, and minor work;

demilune masonry of 1 platform completed; work on new sand parapet, and embankment of traverses and parados; minor work. **73,** 7.

1874. Bastion A: Completion of five 15-inch gun platforms and their breast-height walls, masonry of 2 traverse magazines with connecting parados arch, and necessary doorways, staircases, etc.; work on earth cover and sand parapet nearly completed. Bastion B: Completion of two 15-inch gun platforms, a third nearly finished, foundation of new arch piers in parade completed. Bastion E: Parados arch built; work on 5 new gun platforms in demilune. Breast-height wall for entire battery built; minor work. **74,** 8.

1875. $25,000 app. Battery for five 15-inch guns finished to admit of armament being placed; 3,000 tons of sand placed in parados and cover of magazines; minor work. **75,** 8.

1876. Completion of ravelin battery, and as far as possible of batteries of bastion A of the enceinte; work on modifications of bastion B. **76,** 9.

1877. Repairing earthen slopes, concrete and plastering of magazine arches in bastion B, drains, and asphalt cover. **77,** 7.

1881. Repairs of slopes, casemates, drains, and ironwork. **81,** 20.

1882-84. Repairs of slopes, drains, and buildings. **82,** 16; **83,** 11; **84,** 17.

1885. Repairing sea wall, drains, and casemates; torpedoes painted, 10-inch and 15-inch platforms put in serviceable order; and minor repairs. **85,** 11.

1886. Repairs of cisterns; hanging doors; extra traverse irons placed on 10-inch gun front pintle barbette platforms to adapt them to the new ordnance carriage for 8-inch converted rifles; steamer *Tourist* repaired. **86,** 12.

1887. Est. by BE. for gun and mortar batteries. **87,** 11.

Part 9, FNB. Fort Independence (Castle Island).

1833. Work begun. **80,** 24.

1866. Resetting gun platforms; flagging; cutting out and replacing new pintle for 21 barbette guns in main work; repairing breast-height wall and earthen parapet of northwest exterior battery, and building bombproof magazine chamber of this battery. **66,** 6.

1868. Masonry, concrete, and earth covering of magazine of the northwest exterior battery completed; completion of masonry of southeast exterior battery bombproof traverse; masonry of adjacent magazine begun; parapet cut down; embankment at outer extremity of battery enlarged and raised; and minor work. **68,** 10.

1869. Work on southeast exterior battery magazine, bombproof adjacent completed; slopes repaired; and minor work. Modified plans. **69,** 10.

1870. Est. cost of modifications, $106,000. Earth covering and sodding of east battery magazine completed; repairing breaks in scarp wall and parade wall copings. **70,** 15.

1871. $27,500 app. Modification work begun; necessary buildings for employees built; masonry of 2 new traverse magazines built; minor work. **71,** 10.

1872. $42,500 app. Breast-height walls of east, southeast, and north bastions completed; work on 6 platforms and breast-height walls of northwest bastion; excavation for sand parapet of fronts 1 and 2; minor work. **72,** 7.

1873. $35,000 app. Completion of masonry of 2 center pintle and 4 front pintle 15-inch gun platforms, with their breast-height walls; small magazines on front 1; masonry, earth slopes, and hoisting sand for east bastion; work on earth slopes and excavation for sand parapet of east bastion and curtain of front 1. **73,** 8.

1874. New barbette battery finished ready for armament; completion of new sand parapet, traverse magazines, parade on fronts 1 and 2, 2 traverse magazines on front 3, excavation for sand parapet, and minor work in east exterior battery. **74,** 9.

1875. Modifications of the battery of the enceinte nearly completed; one 15-inch gun platform in east exterior battery finished; work on 2 others, with their breast-height walls, and new parapet in front of battery. **75,** 9.

1876. Completion of proposed modifications of barbette battery of the enceinte, of 5 platforms, ready for armament, in east exterior battery, and minor work. **76,** 10.

1877. Care and preservation. **77,** 7.

1881-84. Repairs of slopes, drains, and buildings, etc. **81,** 22; **82,** 17; **83,** 13; **84,** 19.

1885. Gun platforms put in serviceable condition, and repairs of buildings, wharves, etc. **85,** 12.

1886. Doors hung; ironwork on 15-inch platforms painted; extra traverse irons placed on 10-inch gun platforms to adapt them to the 8-inch converted rifles. **86,** 13.

1898. Castle Isld. turned over to the city of Boston for park purposes, act of May 1, 1890. Public excluded from fort and batteries. **98,** 601.

1899. All explosives removed from the isld. and all torpedo material stored. The isld. again opened to the public. **99,** 711.

Part 10, FNB. Provincetown Harbor—Permanent Forts.

1866. Defenses of this part of the coast to be considered by board of officers. Balance in Treasury, $150,000. **66,** 6.

1867-70. Work awaiting the preparation of plans. **67,** 6; **68,** 10; **69,** 10; **70,** 15.

Part 11, FNB. Long Island Head Battery.

1869-70. Possession of this site, for defense of Broad Sound and the main ship channel, acquired by act of Mar. 28, 1867. Proj. for barbette earthen battery for heavy guns; est. cost, $175,000. **69,** 9; **70,** 15.

1871. $37,500 app. Work begun. Necessary buildings for employees built. **71,** 10.

1872. Work on wharf, excavation for the eastern mortar battery and parados in rear, concrete masonry of these positions, and drainage. **72,** 7.

1873. Completion of drain of eastern part of the battery, 2 large magazine cells and their connected parados arches, foundation of east salient gun platform and its breast-height wall, and excavation for the magazine and parados north of it; minor work. **73,** 7.

1874. $40,000 app. Completion of center-pintle 15-inch gun platform at east salient of the battery, and masonry of adjacent magazine and parados. **74,** 9.

1875. $30,000 app. Work on embankment for traverse magazines and parados; completion of six 15-inch gun platforms with their breast-height walls; minor work. **75,** 8.

1876. Completion of four 15-inch front-pintle gun platforms with their breast-height walls, ready for armament. Work on parados. **76,** 9.

1877. Repairing drains, and grading terrepleins of 2 upper batteries to allow guns to be traversed. **77,** 7.

1881. Repairs made to buildings, gun carriages, etc. **81,** 21.

1882. Repairs to earth slopes and traverse magazines, buildings, etc. **82,** 16.

1885. Gun platforms put in serviceable order; minor repairs to buildings, fences, drains, and slopes. **85,** 11.

1886. Doors hung; repair of slopes, etc.; painting ironwork of gun platforms. **86,** 12.

1887. Est. by BE. for gun and mortar batteries. **87,** 11.

Part 12, FNB. Fort Sewell (Marblehead.)

1884. Fort built 1863–65. History and description. **84,** 17.

Part 13, FNB. Fort Andrew (Plymouth Harbor).

1884. Fort built 1863–65. History and description. Site purchased, 1870. **84.** 19.

Part 14, FNB. Fort Standish (Plymouth Harbor).

1884. Fort built 1862–65. Description. Site purchased, 1870. **84,** 19.

Part 15, FNB. Fort Winthrop and Batteries (Governors Island).

1844. Existing work, consisting of a central casemated keep, and exterior earthen batteries begun in 1844. **80,** 23.

1866. Three bombproof south battery magazines completed, and slopes of east part of battery sodded, earthwork repaired, and bombproof traverse next west of the stone redoubt sodded; work on stone walls, entrance to second traverse magazine west of stone redoubt, south battery; repairing quarters, and minor work. **66,** 6.

1867. Earth covering and sodding of the west magazine, south battery, completed; parapet of south, east, and northwest batteries repaired and sodded; bluff below south battery graded and seeded; northeast and northwest bastions of the earthwork to surround the tower begun; tunnel covered way to south battery excavated; and concrete foundation of its walls laid. **67**, 6.

1868. Work on long covered way between the tower ditch and south battery; raising embankment of the bastions around the tower; repairing embankments of bombproof traverses; minor work. **68**, 10.

1869. Covered way completed and bombproof traverse, opposite, built; earthen counterscarp slopes around tower finished; embankment repaired; minor work. Plans modified. **69**, 10.

1870. Est. cost of modification, $130,000. Earth counterscarp slopes completed; west half of exterior earthwork of tower completed; communication between ditch of the tower and south battery completed; minor work. **70**, 15.

1871. $45,500 app. Modification work begun; concrete masonry, east battery, constr.; drainage and minor work; 3 traverse magazines, south battery, imp. and enlarged; parade reasphalted; and minor work. **71**, 10.

1872. $64,000 app. Work on traverse magazine, platforms, breast-height wall, and sand parapet, east battery; breast-height wall for 4 gun positions, south battery, built; western magazines and shell room, and pit for mortar beds, completed. **72**, 7.

1873. $50,000 app. Completion of new platforms designed for ordnance carriages in east battery, and front-pintle platforms of south battery; work on breast-height wall platform, traverse magazine, and new parapet of south battery; mortar battery completed; and minor work. **73**, 7.

1874. Platform for forty-four 15-inch guns completed; sand parapet of east battery finished, and work on excavation for sand parapet of south battery; 2 new traverse magazines finished, work on a third. **74**, 9.

1875. Completion of masonry of breast-height walls, platforms of two 15-inch guns, necessary ironwork of 4 others; work on breast-height walls for 4 gun positions. Battery, except new sand parapet, completed. **75**, 9.

1876. Completion of east and south batteries (comprising forty-three 15-inch platforms), excepting about one-half of new sand parapet of south battery. **76**, 10.

1877. Repair of slopes and drains. **77**, 7.

1881. Repairs of earth slopes, drains, and buildings; and painting ironwork. **81**, 21.

1882–84. History and condition. Repairs of slopes, etc. **82**, 17; **83**, 12; **84**, 18.

1885. Gun platforms put in serviceable condition; repair of slopes, parade of the tower and buildings. **85**, 12.

1886. Doors hung; painting ironwork of gun platforms; extra traverse irons placed on 10-inch gun platforms to adapt them to the new carriage for 8-inch converted rifles; drain of the tower cleaned and extended. **86**, 13.

Part 16, FNB. Emplacement for 8-inch Guns, Disappearing Carriages.

1891. One emplacement under constr. **91**, 7.

1892. Old masonry demolished. **92**, 5.

Part 17, FNB. Site 4.—Mortar Battery for Sixteen 12-inch Mortars.

1891. Work begun June, 1891. **91**, 7.

1892. $121,039.27 allotted, 1891. Excavation completed; 9,000 c. y. embankment built; 6,700 c. y. concrete placed. **92**, 5.

1893. $10,000 allotted. Masonry and earth embankment nearly completed. **93**, 6.

1894. Embankments and sodding completed. **94**, 7.

1895. Eight mortars mounted; work on 4 platforms. **95**, 7.

1896. $2,786.50 allotted. All platforms finished, mortars mounted, and battery nearly finished. Turned over to Artillery. **96**, 12, 470.

1897. Battery completed. **97**, 602.

1898. $275 allotted for repairs of electric plant. **98**, 595.

1899. $6,400 allotted for repairing slopes, electric plant, and for constr. of power house, etc. **00**, 781.

1900. $375 allotted for hanging doors. **00**, 781.

1901. $6,750 allotted. Work on ventilation and drainage system in progress. **01**, 723.

1902. Drainage system finished; new floors laid; wall of pit repaired. **02**, 644.

Part 18, FNB. Site 5.—Mortar Battery for Sixteen 12-inch Mortars.

1897. Negotiations in progress for purchase of site. **97,** 12, 603.

1898. Jurisdiction over site ceded to National Government by the Commonwealth of Massachusetts, Apr. 6, 1897; plans for emplacements for eight 12-inch mortars prepared and work on excavation begun June 15, 1898. **98,** 595.

1899. $108,000 allotted. Wharf and excavation completed; concrete of magazines and passages placed; mortar platforms made ready to receive base rings; earth embankments and road nearly completed; 8 mortars and carriages received. **99,** 714.

1900. $23,450.10 withdrawn from allotment. Road completed; embankments graded and sodded; armament mounted by hired labor; paving of pits in progress. **00,** 781, 782.

1901. First half, electric-light conduit installed; second half, $113,000 allotted; plans submitted for emplacements for eight 12-inch mortars; plant and quarters erected; drains laid; one-half foundation placed. **01,** 724.

1902. $36,720.41 allotted for second half; concrete work nearly completed. **02,** 644.

Part 19, FNB. Site 5.—Emplacements for Two 6-inch R. F. Guns.

1901. $27,000 allotted. Plans prepared. **01,** 725.

1902. Excavation work for battery; drainage system laid. **02,** 644.

Part 20, FNB. Site 1.—Emplacements for Five 10-inch Guns on Disappearing Carriages.

1892. $156,194.05 allotted, 1890–91. Work on concrete masonry. **92,** 4.

1893. Work on 3 emplacements; 4,000 c. y concrete placed. **93,** 5.

1894. Constr. materials collected for 2 emplacements; some masonry built. **94,** 7.

1895. Three emplacements ready for guns. **95,** 6.

1896. $53,138.16 allotted. Guns not yet received; some concrete work. **96,** 470.

1897. Two 10-inch carriages assembled; work on another one. **97,** 601.

1898. New proj. One carriage assembled and three 10-inch guns mounted; some concrete work. $74,000 allotted. Work begun on 2 other emplacements. **98,** 593.

1899. $46,800 allotted. Three emplacements practically completed except minor work; work on 2 other emplacements nearly completed; the 2 guns and carriages received but not mounted. **99,** 709, 720.

1900. Guns and carriages mounted, completing the emplacements in all respects. **00,** 774.

1901. Plant removed. **01,** 718.

1902. $540 allotted. Roadway built; 2 old-type platform lifts removed; new-type chain hoist purchased and installed. **02,** 642.

Part 21, FNB. Site 2.—Emplacements for Five 10-inch Guns on Disappearing Carriages.

1893. $58,000 allotted. Work begun December, 1892; 2,500 c. y. earth excavated and placed in embankment of 1 emplacement. **93,** 6.

1894. Masonry of 1 emplacement well advanced· materials collected and stored. **94,** 7.

1895. One emplacement ready for gun. **95.** 6.

1896. $21,674.75 allotted. Emplacement will be completed. **96,** 470.

1897. $197,200 allotted. New proj.; completion of emplacements 1, 2, and 3; excavation of emplacement 4 nearly ready for concreting; work on excavation 5; 4 platforms ready for carriages and guns. **97,** 601.

1898. Work on excavation, parapet walls ammunition service, electric-light plant; 5 guns and carriages mounted; battery nearly completed; $4,000 allotted for commanders' stations, and foundations in place. **98,** 594; **99,** 713.

1899. Battery, except minor work, completed. **99,** 712.

1900. Battery completed. **00,** 778.

1901. $10,500 allotted. Lighthouse removed; grading roadway begun; work transferred to Artillery in 1899. **01,** 721.

1902. $1,425 allotted. Road nearly completed; old platform lifts removed; chain hoist partly installed. **02,** 642.

Part 22, FNB. Site 1.—Two Emplacements for 4-inch R. F. Guns.

1898. $9,090 allotted. Work begun, excavations nearly completed; platforms ready for guns. **98,** 593.

1899. Guns mounted, electric light installed, stairs built: minor work. Emplacements completed by July 1, 1899. **99,** 720.

Part 23, FNB. Site 2.—Two Emplacements for 4.72-inch R. F. Guns.

1898. $14,740 allotted. Work begun, guns mounted, excavations finished, and concrete work in progress. **98,** 594.

1899. Guns mounted and battery, excepting minor details, completed. **99,** 722.

Part 24, FNB. Site 3.—Three Emplacements for 12-inch Rifles, Disappearing Carriages.

1898. $151,680 allotted. Work begun April, 1898; platforms ready for mounting guns; excavation completed: magazine work in progress. **98,** 595.

1899. $36,000 allotted. Battery practically completed; 3 carriages on hand. **99,** 713, 721.

1900. $23,800 allotted. Battery completed; guns mounted. **00,** 779, 780.

1901. Steps taken to transfer to Artillery. **01,** 722.

1902. Transferred, 1901. Minor repairs to battery. **02,** 643.

Part 25, FNB. Site 6.—Two Emplacements for 12-inch Rifles, Nondisappearing Carriages.

1898. $4,800 allotted for communication for range-finding service. $80,000 allotted. Survey of site; excavation begun. **98,** 596.

1899. $27,000 allotted. Battery completed in all essential details. Part of 1 carriage received. **99,** 722.

1900. $6,960.30 allotted. Work on slopes; installation of electric-lighting plant, permanent water supply, and minor work. **00,** 782.

1901. Trolleys, cranes, and railing completed. Work transferred to Artillery. **01,** 725.

Part 26, FNB. Site 1.—Two Emplacements for 12-inch Guns on Disappearing Carriages.

1899. $123,000 allotted. Concrete work begun. **99,** 710.

1900. $15,760 allotted. Emplacements completed excepting some work on platforms and mounting guns. **00,** 774.

1901. $5,400 allotted. Platforms completed, armament mounted; tile drain laid: ammunition cranes installed. **01,** 718.

1902. $477.48 allotted. Rooms in old fort cleared of material; walks repaired; connection made to electric motors. **02,** 641, 642.

Part 27, FNB. Site 1.—Three Emplacements for 15-pounder R. F. Battery.

1899 $9,300 allotted. Site laid out ready for excavation. **99,** 711.

1900. $3,450 allotted. Battery completed in all respects, electric-lighting system installed, and guns mounted; work turned over to the garrison. **00,** 775.

Part 28, FNB. Site 7.—Emplacements for Two 6-inch Rifles.

1901. $25,000 allotted. Site surveyed, prepared for work, drains laid; forms erected and foundations laid. **01,** 728.

1902. $7,000 allotted. Battery completed, except laying floors; hanging doors; installing ammunition hoists; grading and sodding parapet. $10,100 withdrawn. **02,** 646.

Part 29, FNB. Site 7.—Emplacements for Four 10-inch B. L. Rifles.

1901. $192,500 allotted. Plans prepared; plant purchased; railroad built; excavation begun. **01,** 728.

1902. (Called site 6 in 1902.) Excavation completed; drains, conduits, speaking tubes placed, for 3 emplacements. **02,** 645, 646.

Part 30, FNB. Site 7.—Three Emplacements for 6-inch R. F. Guns on Disappearing Carriages.

1899. $65,000 allotted. Preparation of plans for wharf and general constr. plant in progress. **99,** 715.

1900. Excavation, and about one-half of concrete work completed. Two carriages received. **00,** 784.

1901. $26,000 allotted. Concrete completed; parapet constr.; electric plant installed; water supply nearly completed; trolleys, handrails, doors placed; 1 carriage received and 3 carriages mounted. **01,** 726.

1902. $1,500 allotted. Parados completed. $4,900 withdrawn. **02,** 646.

Part 31, FNB. Site 6.—Two 5-inch R. F. Guns on Pillar Mounts.

1899. $11,500 allotted. Excavation begun and concrete carried up to the ceiling level. **99,** 715.

1900. $2,550 allotted. Battery completed, excepting setting handrails. Carriages mounted. **00,** 783.

1901. Handrails completed. Battery transferred to Artillery. **01,** 726.

Part 32, FNB. Site 2.—Two Emplacements for 15-pounder R. F. Guns.

1900. $13,200 allotted. Work completed, excepting sodding slopes and providing ammunition lifts; no carriages or guns received. **00,** 779.

1901. $5,580 allotted. Ammunition lifts installed, slopes sodded, bank graded, drain built, armament received and mounted. Battery transferred to Artillery, 1901. **01,** 722.

Part 33, FNB. Site 5.—Two Emplacements for 5-inch R. F. Guns, Pedestal Mounts.

1900. $20,000 allotted. Battery completed ready for armament; neither guns nor carriages received. **00,** 782.

1901. $3,800 allotted. Work completed; no armament received. **01,** 725.

Part 34, FNB. Site 7.—Emplacements for Three 15-pounder R. F. Guns.

1900. $12,000 allotted. Plans prepared and survey of site made. **00, 784.**

1901. Work completed on 2 emplacements, except grading of parapet; $9,000 allotted for constr. third emplacement au. Apr. 11, 1901; concrete work completed. **01, 727.**

1902. Parapet completed, except final grading and sodding. $3,500 withdrawn. **02, 647.**

Part 35, FNB. Site 7.—Emplacements for Four 15-pounder R. F. Guns.

1901. $19,000 allotted. Constr. au. Apr. 24, 1901; railroad constr., derrick, and engine installed; excavation completed, drains laid, forms erected, concrete work begun. **01, 728.**

1902. Battery nearly completed. $5,000 withdrawn. **02, 647.**

MISCELLANEOUS.

Part 36, FNB. Underground Conduit System.

1900. Site 1.—$9,250 allotted. Description of system. 3,000′ of conduit laid. **00, 776.** Site 2.—$3,000 allotted. Work completed. **00, 779.**

1901. Site 1.—Work completed. **01, 720.** Site 3.—$780 allotted. Work completed. **01, 722.**

Part 37, FNB. Central Electric Lighting Plant.

1900. Site 1.—$10,000 allotted. Description of plant, installation of which was completed. **00, 777.** Site 2.—$6,300 allotted. Work completed. Description of plant. **00, 779.**

1901. Sites 1 and 2 transferred to Artillery, 1900. **01, 720, 722.**

Part 38, FNB. Construction of Lighter.

1901. $20,000 allotted. Plans and specifications prepared by naval architect. **01, 729.**

1902. Completed and delivered. **02, 647.**

Part 39, FNB. Construction of Storehouses.

1901. $3,500 allotted for constr. of 2 storehouses, site 6. One storehouse nearly completed, material for second building purchased, site prepared. **01, 729.**

1902. Both storehouses finished. **02, 645.**

Part 40, FNB. Roadway at Winthrop.

1902. Letters and indorsements from Sec. of War, Chief of Engineers, Judge Advocate General, act of Congress. Deeds and conveyances referring to a strip of land purchased by U. S. for present site of Fort Banks. It is recom. that U. S. dedicate to town of Winthrop another strip of land to be used as a public highway, and that $200 be app. for grading and making roadway through middle of said strip. **02,** 651, etc.

Part 41, FNB. Moving and Mounting Guns and Carriages.

1900. Site 1.—$1,100 allotted. Two 10-inch guns and carriages moved from wharf to emplacements, to be mounted by the garrison. **00,** 777. Site 6.—$1,200 allotted. Two 12-inch carriages mounted; no guns on hand. **00,** 783.

1901. Site 1.—$2,940 allotted for two 12-inch guns moved from wharf and mounted in emplacements by hired labor. **01,** 720. Site 6.—$6,821.43 deposited to credit of Treasurer of U. S. **01,** 726.

Part 42, FNB. Preservation and Repair of Fortifications.

1898. $275 allotted for repair of electric plant, mortar battery at Fort Banks. **98,** 595. $800 allotted for cleaning and painting mine cases. **98,** 601.

1899. $500 allotted for repairs at Fort Strong, $415 for repairs at Fort Banks, $365 for repairs at Fort Andrews, and $365 for repairs at Fort Revere. $800 allotted for repair of 10-inch and 12-inch emplacements and $200 allotted for relaying flagging, Fort Warren. $175 allotted for repairing bridge of old works, Fort Winthrop; and $2,200 for repair of wharf, Fort Independence. **99,** 717, 718.

1900. $675 allotted for general repair of batteries and their power plant, Fort Warren; $300 allotted for general repairs of plant and $4,250 allotted to prevent dampness in magazine at Fort Strong; $210 allotted for demolition and removal of old buildings occupying ground required for other purposes, Fort Strong; $800 allotted for care and repair of plant, Fort Heath; $330 allotted for repairs at Fort Banks; $1,000 allotted for repair and care of Fort Andrews; $1,860 allotted for general care and repair at Fort Revere; $250 allotted for repairs at Fort Standish. **00,** 786–89.

1901. $230 allotted for Fort Warren; repairs to lighting system; ammunition lifts; walls of power room painted. **01,** 730. $790 allotted for Fort Strong; old engineer building demolished. Following allotments made: $1,120 for Fort Heath; $110 for Fort Banks; $425 for Fort Andrews; $220 for Fort Revere; $100 for Fort Standish. **01,** 730, 731, 732, 733.

1902. Minor repairs made to buildings and batteries. Withdrawals: Fort Independence, $9.87; Fort Warren, $44.04; Fort Strong, $0.03; Fort Banks, $238.94; Fort Andrews, $385.20. Allotted: Fort Warren, $200. **02,** 649. Fort Heath, $527.84 allotted, $0.18 withdrawn **02,** 643.

Part 43, FNB. Range and Position Finders.

1900. $4,605 allotted. Commander's station completed; $8,400 allotted for 2 additional range-finder stations, site 1. **00,** 776. Total of $5,385 allotted for commander's station at site 2, completed **00,** 778. Site 3.—$6,400 allotted. Work begun. **00.** 780.

1901. $4.020 allotted. Two stations at site 1 completed. **01,** 719. Commander's station, site 2, transferred to Artillery, 1900. **01,** 721. Site 3.—$2,600 allotted. Work completed. **01,** 722.

Part 44, FNB. Sites.

Grovers Cliff. Fifty acres acquired in 1891. **92,** 9. Eight small lots acquired by purchase. **93,** 10. Total area acquired, $50\frac{1}{16}$ acres for $263,-997.79. **94,** 13.

Peddocks Island. $33,130 allotted for purchase of 33.13 acres. **98,** 599.

Deer Island. 23.34 acres transferred by Boston to the U. S.; more land wanted by U. S. City did not feel justified in transferring any more land at the time. **98,** 600; **99,** 719.

Nantasket Head $251,248.85 allotted. About 40 acres acquired by purchase. **98,** 600.

Nahant. Report, as to desirable land, to be submitted later. **98,** 600; **99,** 719. Description of land acquired. **99,** 718; **00,** 789. $1,000 allotted for survey. **00,** 791.

1901. Acquisition of about 239,078.9 sq. f.; 49 lots paid for. **01,** 734.

1902. Part of tract purchased. **02,** 648.

Part 45, FNB. Submarine Mines.

1891. Two mining casemates completed, one each at Forts Warren and Strong. **91,** 7.

1893. $27,000 allotted. Work begun, third casemate, Fort Standish. **94,** 7.

1894. Masonry and entrance gallery completed: work on cable gallery and sand embankment, Fort Standish. **94,** 7.

1895. Masonry casemate and gallery of third casemate finished and sand cover nearly completed. **95,** 7.

1897. $4,300 allotted. Work on cable tank at Fort Strong. **97,** 602.

1898. Cable tank nearly completed: $1,035 allotted for removal of torpedo material from Fort Warren to base of operations at Fort Independence; $25,000 allotted for purchase of additional torpedo material: $68,700 allotted for planting mines. Description of mines, material, and the planting **98,** 597. $800 allotted for cleaning and painting mine cases. **98,** 601.

1899. $700 allotted for storehouse at Fort Independence; $2,000 and $2,700 for casemates, Forts Warren and Strong; $2,000 for storage of material at Fort Independence. Storehouse completed; Fort Strong casemate begun; storage practically completed. $76,847.18 allotted for planting and removing mines, and purchasing and cleaning torpedo material. Mines removed. **99,** 716, 723.

1900. $850 allotted, for casemate. Fort Strong, completed; and one, Fort Warren, practically completed; $1,600 allotted and torpedo material cleaned and stored at Fort Independence. $600 withdrawn from $2,000 allotment. **00,** 785, 787.

1901. Casemate completed. **01,** 729. $7,000 allotted for cable tank extension, Fort Strong shed constr.: hoisting device partly constr. **01,** 730. $605 allotted and unserviceable material shipped to Willetts Point. **01,** 731.

1902. Cover for cable tank completed; trolleys purchased and installed. **02,** 647. Material for mines transferred to Fort Independence. $47.99 withdrawn, $100 allotted. **02,** 648.

Part 46, FNB. Supplies for Coast Defenses.

1900. $1,000 allotted or purchase of electrica supplies; none purchased. **00,** 791.

1901. Supplies purchased and issued to commanders. **01,** 734.

1902. $1,300 allotted. Electrical supplies purchased. **02** 648.

FNC. MASSACHUSETTS AND RHODE ISLAND FORTIFICATIONS.

(NOTE.—Reports on these works from 1903 to 1912 are of a general character only. See the first 15 pages of each annual report from 1903 to 1912.)

Part.	Title.	Period.
1	Contracts	1897–1902
2	Engineering features	....
3	Engineers—Chief of Engineers	1866–1902
4	B E	1882–1887
5	In charge	1865–1901
6	Assistants	1893–1901
7	Forts, etc.—Operations, allotments, etc	1824–1902
8	New Bedford, Mass.—Clarks Point (fort)	1857–1886
9	Fort Phoenix	1866
10	Mounting 8-inch converted rifles	1898
11	Two emplacements, 8-inch guns, disappearing carriages	1897–1900
12	Four emplacements, 5-inch R. F. guns	1899–1902
13	Four 15-pounder R. F. guns	1901–1902
14	Newport Harbor, R. I.—Fort Adams	1824–1886
15	Fort Green, R. I.	1885
16	Narragansett Bay, R. I.—Dutch Isld	1863–1886
17	Conanicut Isld.—Dumplings Battery	1870
18	Emplacements, three 10-inch guns, disappearing carriages	1897–1900
19	Mortar battery, sixteen 12-inch mortars	1897–1900
20	Two emplacements, 10-inch rifles, disappearing carriages	1898–1899
21	Two emplacements, 4.7-inch R. F. guns, pedestal mounts	1898–1899
22	One emplacement, 8-inch B. L. rifle	1898
23	Mortar battery, eight 12-inch mortars	1898–1901
24	One emplacement, 6-inch R. F. gun	1898–1899
25	Two emplacements, 12-inch rifles, nondisappearing carriages	1898–1900
26	Two emplacements, 3-inch 15-pounder R. F. guns	1899–1900
27	Two 15-pounder R. F. guns	1899–1900
28	Three emplacements, 10-inch guns	1901–1902
29	Four emplacements, 6-inch R. F. guns	1901–1902
30	Two emplacements, 15-pounder R. F. guns	1901–1902
31	Emplacements, 6-inch and 12-inch R. F. guns	1901
32	Emplacements, three 12-inch guns	1901
33	Miscellaneous.—Electric-light plant; constructing wharf; fire control and searchlight	....
34	Preservation and repairs	1898–1902
35	Range and position finders	1898–1902
36	Sea walls and embankments	1901
37	Sites	1895–1902
38	Submarine mines	1892–1902
39	Supplies	1901

Part 1, FNC. Contracts.

1897. Sand, $1.25 per c. y.; small stone, $1.81 per c. y.; Rosendale cement, 85¢ per barrel; Portland cement, $2.12 per barrel. **97**, 604. Three 10-inch emplacements, $56,967 for 2. **97**, 606.

1899. Rosendale cement, 68¢ per barrel; small stones, $1.80 per c. y.; sand, $1.35 per c. y.; Portland cement, $2.15 per barrel. **99**, 737.

1901. Crushed stone, $1.57 per c. y.; sand, $1.30 per c. y.; Giant Portland cement, $2.26 and $1.80 per barrel; lumber, $21 per M f. planed, $17, per M f. rough. **01**, 736. Conduit, switches, junction boxes, etc.; switchboards, covered cable, generating sets. **01**, 739.

1902. Building sea walls. **02**, 663. Book tiles; constr. wharf. **02**, 665.

Part 2, FNC. Engineering Features.

Asphalt, placing. **00**, 809.

Cement, test. **96**, 471.

Concrete, painting. **03**, 2386.

Dampproofing. (See Waterproofing, below.)

Foundations. **03**, 2384; **04**, 3712.

Magazines, linings for. **02**, 2458 (pl.); **03**, 2385; **04**, 3712.

Materials and work, cost of. **99**, 726, 733, 735; **00**, 803, 805, 809, 811.

Mining casemate. **96**, 471.

Waterproofing. **00**, 795, 799, 809; **02**, 2458.

Part 3, FNC. Engineers.

Chief of Engineers. **R.**, **66**, 6; **67**, 6; **68**, 10; **69**, 10; **70**, 15; **71**, 11; **72**, 8; **73**, 8; **74**, 9; **75**, 9; **76**, 10; **77**, 7; **78**, 9; **79**, 13; **80**, 24; **81**, 22; **82**, 17; **83**, 13; **84**, 19; **85**, 12, 423; **86**, 14; **93**, 6; **94**, 7; **95**, 7, 503; **96**, 12, 471; **97**, 12, 603; **98**, 16, 601; **99**, 15, 724; **00**, 16, 791; **01**, 16; **02**, 18.

Part 4, FNC. Board of Engineers.

Constituted, 1882, to consider and report upon the condition of fortifications, and what number, if any, could be dispensed with. **R.**, **82**, 416. **R.** 1887, **87**, 11.

Part 5, FNC. Engineers in Charge.

Capt. H. M. Robert, 1865.
Maj. G. H. Mendell, 1866–67.
Capt. S. M. Mansfield, 1866.
Maj. D. C. Houston, 1866–70.
Capt. J. A. Smith, 1867–69.
Lt. Col. G. K. Warren, 1870–82.
Capt. A. H. Holgate, 1870.
Maj. J. W. Barlow, 1882.
Lt. Col. G. H. Elliot, 1882–93.
Capt. W. H. Bixby, 1893–95.
Lt. W. W. Harts, 1895–96.
Maj. D. W. Lockwood, 1896–1901.
Maj. G. W. Goethals, 1901.
Lt. R. P. Johnston, 1900–01.

Part 6, FNC. Assistants.

Lt. W. H. Harts, 1893–95.
Capt. C. H. McKinstry, 1896–98.
Lt. W. B. Ladue, 1898–99.
Lt. W. J. Barden, 1898.
Capt. Harding, 1898–99.
Lt. R. P. Johnston, 1899–1901.

Part 7, FNC—

FORTS AND BATTERIES.

Part 8, FNC. New Bedford Harbor, Mass.—Clarks Point (Fort).

1857. Work begun for casemated fort. **80**, 24.

1866. Work on scarp of water fronts, parade wall, square towers, excavation; minor work. **66**, 6.

1867. Three casemates made ready for guns; masonry of 5 magazines completed, and 3 magazines made ready for powder. Work on scarp and parade walls. **67**, 6.

1868. Scarp and parade walls completed, work on foundations for breast-height wall and gun platforms; mastic covering of roofs. **68**, 10.

1869. Completion of first and second tiers, except quarters; mastic covering of roof surfaces and magazines, 3 barbette magazines, breast-height wall, parapet, and terreplein of gorge and 2 rectangular stairs. **69**, 10.

1870. This casemated work completed except its barbette battery over the casemates. BE. recom. that nothing further be done than to preserve it from deterioration, and that an earthen barbette battery for twenty-six 15-inch S. B. or equivalent rifled guns be erected on the hill in rear of the fort. Repair and preservation. **70**, 15.

1874. Minor repair of buildings **74**, 9.

1875. Plans for heavy gun batteries completed; est., $181,344.80. Minor repairs of plant. **75**, 9.

1876–79. Preservation and repair. **76**, 10; **77**, 7; **78**, 9; **79**, 13.

1884. Painting ironwork, mowing slopes, repairing fences, buildings, etc. **84**, 20.

1885. Storing engineer property; temporary doors provided for magazines. **85**, 13.

1886. Repairs of buildings, magazine doors, and bridges. **86**, 14.

Part 9, FNC. New Bedford Harbor, Mass.—Fort Phoenix.

1866. Magazine anteroom floored, and 2 doors hung. **66,** 7.

Part 10, FNC. New Bedford Harbor, Mass.—Mounting 8-inch Converted Rifles.

1898. $1,800 allotted. Work begun. **98,** 602.

Part 11, FNC. New Bedford Harbor, Mass.—Two Emplacements for 8-inch Guns on Disappearing Carriages.

1898. $50,000 allotted. Work begun, excavation completed, and platforms ready for guns. **98,** 602.

1899. $53,500 allotted. Guns mounted and work completed, except electric lighting. **99,** 724, 725

1900. Repairs of slopes. Batteries transferred to the Artillery. **00,** 791.

Part 12, FNC. New Bedford Harbor, Mass.—Four Emplacements for 5-inch R. F. Guns.

1899. $13,300 allotted. Plans and est. approv. for pedestal mounts. **99,** 729.

1900. $4,200 allotted. Work begun, excavation completed, and concrete work in progress. **00,** 792.

1901. $4,000 allotted. Work on emplacements completed; ready for guns and electric lighting. **01,** 735. Chief of Engineers decides to drop two 5-inch guns, substituting four 15-pounder R. F. guns instead. **01,** 736.

1902. Repairing bombproof and angle of east wing wall. **02,** 659.

Part 13, FNC. New Bedford Harbor, Mass.—Four 15-pounder R. F. Guns.

1901. Substituted for two 5-inch R. F. guns. $18,300 allotted. Both batteries practically completed. **01,** 736.

1902. Doors hung and painted; emplacement repaired. **02,** 659.

Part 14, FNC. Newport Harbor, R. I.—Fort Adams (Narragansett Bay).

1824. Work begun. **80,** 24.

1866. Work on refacing 2 embrasures; repairs to slopes; replacing granite wall above the coping with earthen parapet; building 2 traverse magazines; and laying platforms for two 15-inch and two 10-inch guns. **66,** 7.

1867. Relaying traverse circles; 4 additional platforms laid; 2 service magazines built. Work begun on exterior batteries to adapt them to an armament of 15-inch and heavy rifled guns; minor work. **67,** 7.

1868. Wharf repaired, new postern gates built; minor repairs to drains, coping, sidewalks, casemates, arches, etc. **68,** 11.

1869. General repairs of masonry, sea wall, wharf, and quarters. **69,** 11.

1870. Modification plans approv. for an exterior barbette battery for heavy guns; est., $132,000. Work on latrines, repairing wharf; minor work. **70,** 16.

1871. Repairing wharf, quarters, southeast glacis; minor work. **71,** 11.

1872. $85,000 app. Repairs of roads, etc. Preparing for modification work. **72, 8.**

1873. $65,000 app. Work begun on modification. Work on parapet, roads, and quarters. **73, 8.**

1874. $20,000 app. Completion of concrete for 6 magazines—traverses. Work on parapet, terreplein, wharf; drainage system completed. **74, 10.**

1875. $15,000 app. Foundations for platforms for 6 heavy guns laid, and earth of 2 traverses, with bonnets, completed; work on and repairs of slopes. **75, 9.**

1876. Four platforms set; grading slopes; drainage work; preservation and repairs. **76, 10.**

1877. Care and preservation. **77, 8.**

1878. Fence built. **78, 10.**

1882. $10,000 allotted in 1881 for repairs of wharf; $1,000 allotted for waterproofing casemate; rebuilding bridges and repair of buildings. **82, 18.**

1883. Waterproofing work; casemates ventilated by removing the brick cheeks of the embrasures and loopholes; repair of buildings and wharf. **83, 14.**

1884. Preservation and repair—finishing wharfs, repairing facings of 6 embrasures, sea wall, walks, etc. **84, 20.**

1885. Work on waterproofing, sea wall, repairing facings of embrasures, drainage, and minor work. **85, 14.**

1886. Ironwork of 4 front pintle platforms for 15-inch or heavy rifled guns completed; flooring of 2 magazines; work on drainage, sea walls, breast-height walls, and waterproofing. **86, 14.**

Part 15, FNC. Newport Harbor, R. I.—Fort Green, R. I. (Narragansett Bay).

1885. Resolution of the Senate, Jan. 9, 1885, requested information concerning the possession and occupancy of Fort Green; report submitted by officer in charge, recom. transfer of the land to the city of Newport for use as a public park. History. **85, 15, 423.**

Part 16, FNC. Dutch Island, Narragansett Bay, R. I. (Western End).

1863. Work begun on temporary defenses. **80, 24.**

1866. Site purchased, temporary work; upper and lower battery completed during year. Proj. being prepared for permanent defenses. **66, 7.**

1867. Work begun on permanent defenses in March—altering earthen battery built during the war. Minor work and repairs. **67, 7.**

1868. Work on altering upper battery to adapt it to an armament of 15-inch guns, on permanent wharf, and removing buildings. **68, 11.**

1869. Same as previous year, and general repairs to wharf, drains, and buildings. **69, 11.**

1870. Proj. for 3 detached barbette batteries for forty 15-inch S. B. or equivalent rifle guns; est., $206,477. Work on buildings, wharf, etc. **70, 16.**

1871. $121,998 reapp. Work begun, general repair of plant. **71, 12.**

1872. New plans approv.. Work begun, foundations of 2 service magazines completed and 2 others begun. Minor work. **72, 9.**

1873. $40,000 app. Concrete work of 4 magazines. **73, 9.**

1874. $20,000 app. Traverses of 4 magazines covered in with sand and sodded; parapet connecting them completed for a breast height of 7′; work on water supply, drainage system, and on minor repairs of plant. **74, 10.**

1875. $20,000 app. Work on water supply, drainage system, grading ground in front and rear of battery, and seeding same; foundations of 2 platforms laid and 2 platforms received. **75, 10.**

1876. Platforms for 4 guns laid, breast-height wall completed; work on parapet; and preservation and repair. **76, 11.**

1877-79. Care and preservation. **77, 8; 78, 10; 79, 13.**

1884. Preservation and repair—painting ironwork; renewing shot beds and skiddings for guns; repairs to ventilating chimneys o magazines, building, and dock etc. **84, 21.**

1885. Preservation and repairs—repairs of quarters, slopes. **85, 14.**

1886. Work on ironwork of 1 center pintle and 4 front pintle 15-inch or heavy rifled guns, and fitting up 2 service magazines by placing floors and doors; minor repairs of wharves, buildings, etc. **86, 15.**

Part 17, FNC. Conanicut Island, R. I.—Dumpling's Battery.

1870. On site of old Dumplings tower, proj. for a barbette battery for ten 15-inch S. B. or equivalent rifle guns on site of the ruins of an old casemated tower, built about the close of the last century on Conanicut Isld. opposite Fort Adams. Est., $100,000. **70, 16; 74, 10.**

Part 18, FNC. Narragansett Bay, R. I.—Emplacements for Three 10-inch Guns on Disappearing Carriages.

1897. $99,400 allotted. Work begun for constr., by contract, of 3 emplacements; excavating and concreting in progress. **97,** 605.

1898. $12,000 allotted. Two old magazines removed by contract; work of mounting guns and carriages completed; installing electric-lighting plant; cost of labor and materials. **98,** 607.

1899. Storage battery installed. Battery turned over to the Artillery. **99,** 737.

1900. New locking devices to ammunition lifts installed; dampness in magazines corrected. **00,** 807.

Part 19, FNC. Narragansett Bay, R. I.—Mortar Battery for Sixteen 12-inch Mortars.

1897. $125,500 allotted. Work begun. Necessary excavation done by contract. Work on platforms and walls in progress. **97,** 603.

1898. $10,000 allotted. Battery completed, guns and carriages mounted, storage battery installed, and turned over to the Artillery on June 6, 1898. **98,** 603.

1899. $240 allotted for repairs of slopes, parapet, and concrete floors. **99,** 730.

1900. Building shelter for projectiles. **00,** 798.

Part 20, FNC. Narragansett Bay, R. I.—Two Emplacements for 10-inch Rifles, Disappearing Carriages.

1898. $74,000 allotted. Work begun; 1 gun and carriage mounted. **98,** 604.

1899. $18,620 allotted. Guns mounted and tested; battery completed except electric lighting; battery turned over to the Artillery. **99,** 731.

Part 21, FNC. Narragansett Bay, R. I.—Two Emplacements for 4.7-inch R. F. Guns on Pedestal Mounts.

1898. $12,000 allotted. Work begun, and platforms ready to receive guns by May 23. **98,** 605.

1899. $5,000 allotted. Guns mounted and tested; battery completed and transferred to the Artillery. **99,** 733.

Part 22, FNC. Narragansett Bay, R. I.—One Emplacement for 8-inch B. L. Rifle.

1898. $3,000 allotted. Work begun and completed for making the necessary changes in the 15-inch carriage for the 8-inch rifle (B. L.); carriage ready for mounting rifle. **98,** 606.

Part 23, FNC. Narragansett Bay, R. I.—Mortar Battery for Eight 12-inch Mortars.

1898. $2,500 allotted. Survey o site made; plans and est. being prepared. **98,** 608.

1899. $125,000 allotted. Work begun and about 40% completed. **99,** 737.

1900. $15,900 allotted. Work about 95% completed. **00,** 808.

1901. Transferred to Artillery, Jan. 22, 1901. **01,** 744; **02,** 665.

Part 24, FNC. Narragansett Bay, R. I.—One Emplacement for 6-inch R. F. Gun.

1898. $8,000 allotted. Work done by contract completed and gun mounted; cost of labor and materials. 98, 608.

1899. $250 allotted. Minor repairs of parapet, etc. 99, 739.

Part 25, FNC. Narragansett Bay, R. I.—Two Emplacements for 12-inch Rifles, Nondisappearing Carriages.

1898. $40,000 allotted. Work begun on excavation. 98, 609.

1899. $93,708.44 allotted. Guns mounted, and battery completed, except installation of electric plant; some embankment and sodding work, and minor details. 99, 742.

1900. General repairs. 00, 802.

Part 26, FNC. Narragansett Bay, R. I.—Two Emplacements for 3-inch 15-pounder R. F. Guns.

1899. $10,000 allotted. Plans and est. approv. 99, 740.

1900. Work begun Two old S. B. 15-inch guns dismounted and, with their carriages, removed from site of work; excavation in progress. 00, 812.

Part 27, FNC. Narragansett Bay, R. I.—Two 15-pounder R. F. Guns.

1899. $11,065 allotted. Work begun, excavation completed; concrete completed, except loading platforms. 99, 741.

1900. Guns and carriages not received. 00. 804.

Part 28, FNC. Narragansett Bay, R. I.—Three 10-inch Gun Emplacements.

1901. $122,500 allotted. Road built, objectionable grades reduced; temporary storage structures begun. 01, 741.

1902. $55,800 allotted. Buildings completed; walls practically completed to ceiling level. 02, 663, 664.

Part 29, FNC. Narragansett Bay, R. I.—Four 6-inch R. F. Guns.

1901. $35,000 allotted. Road built; grading; storage structures built. 01, 742.

1902. One battery practically completed, ready for guns. $33,880 allotted for second battery; excavation for emplacements completed. 02, 664.

Part 30, FNC. Narragansett Bay, R. I.—Emplacements for two 15-pounder R. F. Guns.

1901. $15,000 allotted. Work on temporary structures, roadway, grading, etc., begun. 01, 742.

1902. Battery practically completed; lined with Shawnee brick, and 6-inch air spaces. 02, 665.

Part 31, FNC. Narragansett Bay, R. I.—Emplacements for 12-inch and 6-inch R. F. Guns.

1901. $500 allotted. Land surveyed, plans and est. submitted. 01, 743

Part 32, FNC. Narragansett Bay, R. I.—Emplacements for Three 12-inch Guns.

1901. $240,000 allotted. Timber wharf built; excavation completed; rooms finished to ceiling level; gun platforms finished. $3,500 withdrawn. **02,** 663.

Part 33, FNC. Miscellaneous.

Electric-light plant:

1901. $48,200 allotted for plant at Narragansett B., R. I.; conduit laid. **01,** 738, 739.

1902. $5,000 allotted. Completed. **02,** 661.

1901. $37,950 allotted. Electric-light plant at mortar battery; site surveyed and plans prepared. **01,** 744.

1902. Interior wiring of batteries completed. **02,** 661.

Constructing wharf:

1901. $28,500 allotted for building permanent wharf on site of old temporary wharf, Narragansett B. All old material removed; 2,700 tons st., 400 y. r. placed. **01,** 742.

1902. Wharf completed. **02,** 667.

Fire-control system and searchlight:

1902. New Bedford. $3,400 allotted for installing the telautograph and cables for a 24-inch searchlight. **02,** 660.

Narragansett B. $9,700 allotted. Survey made. **02,** 668. $3,500 allotted for cable switches, receptacle boxes, etc., for searchlights borrowed for use of maneuvers to take place in fall. **02,** 669.

Part 34, FNC. Preservation and Repair of Fortifications.

1898. $7,700 allotted. Rebuilding breast-height wall; parapet work completed; repairing brick walk, break in sea wall, and platforms of 8-inch converted rifles. **98,** 606.

1899. $400 allotted for New Bedford H. **99,** 729. Narragansett B.—$6,495.50 allotted. Repairing sea wall and parade wall and buildings; minor repairs. **99,** 735. $1,879.82 allotted for repairing bracket hangers and for minor work. **99,** 740

1900. $420 allotted for minor repairs; $600 allotted for storing mining material at New Bedford H. **00,** 798. $1,165 allotted for correcting dampness in magazine, care of mining material, wiring mining casemates, repairs of quarters, repairing ventilators and culvert, and minor work. **00,** 800. $975 allotted for correcting dampness in dynamo room. **00,** 805. $1,730 allotted for correcting dampness in 10-inch battery. **00,** 813.

1901. New Bedford. $186 allotted. Painting and scraping I beams and ironwork. **01,** 736.

Narragansett B. $3,760 allotted. Observations of dampness made, bulging casemate wall removed, care of torpedo material, buildings painted, etc. **01,** 740. $543.20 allotted. Engine room waterproofed; painting and scraping 12 and 15 pound gun emplacements. **01,** 743. $1,015 allotted. Roadway, rear of three 10-inch gun battery, macadamized and rolled; at 6-inch battery, leaks in magazine stopped, ironwork painted and scraped. **01,** 744, 745.

1902. New Bedford H., Mass. Painting, minor repairs, and magazine lined. **02,** 659.

Narragansett B. $1,725 allotted for general repair work; $600 allotted for care of torpedo material; $1,200 allotted for salary of electrician; $1,325 allotted for storage shed for projectiles. **02,** 666.

Part 35, FNC. Range and Position Finders.

1898. $2,300 allotted for a tower for temporary installation of a Lewis range finder at Narragansett B., R. I.; completed and sheathed with 12 inches of timber and steel plates. **98,** 604.

1899. $90 allotted for installation of 2 range finders; $2,420 allotted for constructing a battery-commander's station. **99,** 736. $30 allotted for installing 2 range finders; $4,950 for constructing a battery-commander's station. **99,** 740.

1900. $25 allotted for installing a range finder, location not definitely decided upon. **00,** 797. $935 allotted for revised work on battery-commander's station; work begun and completed, and turned over to the Artillery. **00,** 799. Battery-commander's station completed, and turned over to the garrison; total cost, $4,044.33. **00,** 810.

1901. Narragansett B. Battery-commander's station painted and iron ring put around base. **01,** 739.

1902. New Bedford. $2,365 for erection of range-finder station. **02,** 660.

Narragansett Bay—$2,277 allotted for constr. fire-commander's station at eastern entrance, practically completed. $3,200 allotted for battery-commander's station for 12-inch gun battery, practically completed. $2,153.80 allotted for fire-commander's station at western passage, completed. **02,** 667. $5,026 allotted for battery-commander's station, completed. **02,** 668.

Part 36, FNC. Sea Wall and Embankments.

1901. $13,000 allotted for rebuilding sea wall at Narragansett B. **01,** 739.

1902. Completed. **02,** 662.

Part 37, FNC. Sites.

Fort Adams—Narragansett B. Suit of ejectment begun against occupant of three-fourths acre; judgment rendered in favor of defendant; suit begun to determine and fix the U. S. boundaries at this disputed locality. **95,** 13, 503. Fort Wetherill—Description of sites acquired by condemnation proceedings. **98,** 611. Condemnation proceedings instituted against owners of land needed for fortification purposes. **99,** 746. A total of $261,555.94 allotted for purchase and survey of land; 32 acres of one site and 31.67 acres of another site acquired by condemnation proceedings. **00,** 806, 807.

1901. Narragansett B. $65,000 allotted for purchase of land; $1,000 allotted for survey. **01,** 746.

1902. $16,000 allotted toward purchase of about 20½ acres. **02,** 669.

Part 38, FNC. Submarine Mines.

1892. Plans and est. for 2 mining casemates for defense of Narragansett B. in preparation. **92,** 8.

1893. Work of excavation begun on 1 casemate at Narragansett B. **93,** 6.

1894. Completion of 1 casemate and work on the other at Narragansett B. **94,** 7.

1898. $5,000 allotted for planting mines in New Bedford H. **98,** 602. Cable tank completed at Narragansett B. $11,000 allotted for planting mines in Narragansett B. **98,** 610.

1899. $13,500 allotted for mining casemate at New Bedford H. **99,** 729. $3,400 allotted for cable tank at New Bedford H.; excavation nearly finished. **99,** 729. Mines not planted in New Bedford H., as enough material and supplies had not been received before operations were suspended. **99,** 730. Narragansett B.—$1,000 allotted for caring for and storing mining material. $6,700 allotted for a torpedo storehouse. **99,** 736. $11,080 allotted for a mining casemate that would be free from dampness. **99,** 740. $10,000 allotted for planting and removing and caring for torpedo material. **99,** 746.

1900. Work on mining casemate at New Bedford H. **00,** 794. Cable tank completed. **00,** 794. $300 allotted for readjusting the discharge pipe leading from the cable tank; work completed. **00,** 800. Mining casemate nearly completed **00,** 811.

1901. New Bedford. $4,500 allotted. Torpedo storehouse practically completed. **01,** 738. $150 allotted for transfer of torpedo material; cable to be tested. **01,** 738.

Narragansett B. $250 allotted. Overhauling torpedo material; transferred to Artillery. **01,** 741. $4,000 for constr. torpedo storehouse. **01,** 745. $4,000 allotted for constr. cable tank; practically completed. **01,** 746.

1902. New Bedford. Cable tested; transferred to Artillery. **02,** 659. Mining casemate lined; transferred to Artillery. **02,** 660. Torpedo storehouse entirely completed; transferred to Artillery. **02,** 660.

Narragansett B. Torpedo storehouse completed. **02,** 666, 667. Cables tested. **02,** 667.

Part 39, FNC. Supplies for Seacoast Defenses.

1901. $800 allotted for Narragansett B. **01,** 746; **02,** 668.

FND. CONNECTICUT FORTIFICATIONS.

(NOTE.—Reports on these works from 1903 to 1912 are of a general character only. See the first 15 pages of each annual report from 1903 to 1912.)

Part.	Title.	Period.
1	Contracts	1897–1902
2	Engineering features	
3	Engineers—Chief of Engineers	1866–1902
4	BE	1882–1898
5	In charge	1866–1902
6	Assistants	1897–1902
7	Forts, etc.—Operations, allotments, etc	1838–1902
8	New London, Conn.—Fort Trumbull, at "Fort Point"	1838–1902
9	Battery at Fort Griswold, Groton, Conn	1840–1902
10	Bridgeport, New Haven, New London, at Stonington—Temporary defenses	1898–1899
11	New Haven, Conn.—Fort Hale	1866–1882
12	Emplacements, two 12-inch guns, disappearing carriages	1896–1901
13	Emplacements, two 10-inch rifles, disappearing carriages, and mining casemate	1897–1901
14	Emplacements, eight 12-inch B. L. mortars	1897–1901
15	Emplacements, two 10-inch B. L. rifles, disappearing carriages, model 1896	1898–1901
16	Emplacement, 4.7-inch R. F. gun	1898–1900
17	Emplacements, two 8-inch B. L. rifles, barbette carriages (15-inch S. B. converted)	1898–1901
18	Emplacements, 6-inch R. F. guns, disappearing carriages	1899–1901
19	Emplacements, two 8-inch B. L. rifles, disappearing carriages, and 2 emplacements for 5-inch R. F. guns, balanced pillar mounts	1899–1901
20	Emplacements, two 12-inch B. L. rifles, disappearing carriages (1897); two 10-inch B. L. rifles, disappearing carriages (1896); three 6-inch R. F. guns, disappearing carriages	1899–1901
21	Emplacements, two 5-inch R. F. wire-wound guns, with parados	1899–1901
22	Emplacements, two 5-inch R. F. wire-wound guns	1900–1901
23	Emplacements, 5-inch wire-wound guns	1900–1901
24	Emplacements, eight 12-inch B. L. steel mortars	1901
25	Emplacements, two 6-inch R. F. guns	1901
26	Various sites (Nos. 1, 2, 3, 4, 5), miscellaneous works	1902
27	Miscellaneous (protection of dynamite battery; care of electric plant)	1901
28	Preservation and repairs	1899–1901
29	Range and position finders	1899–1901
30	Sea walls and embankments	1901
31	Sites	1898–1900
32	Submarine mines	1898–1901

Part 1, FND. Contracts.

1897. Two 12-inch emplacements and wharf, $106,628.80. **97,** 609.

1898. Entire electric plant for two 12-inch emplacements, $5,290. **98,** 613. Two 10-inch emplacements with casemate and wharf, $102,427. **98,** 615. Electric apparatus complete for 10-inch emplacement, $2,710.38. **98,** 615. Hornsby-Akroyd oil engine and belt, $1,695. **98,** 615.

1899. Small stone, $1.18 and $1.24 per c. y.; proposals for constr. materials. **99,** 753.

1900. Electric-light plant for mortar battery, $6,482. **00,** 818. Six-inch emplacements—5 hoists and doors, $2,765; 10-inch emplacements—2 hoists and doors, $1,807; 12-inch emplacements—2 hoists and doors, $1,847. **00,** 820, 825. Electric-light plant for two 8-inch and 2 5-inch emplacements $1,451. **00,** 821.

1902. Building repairs, $183. **02,** 670. Constr. sheet-pile revetment, $6 l. f. **02,** 671. Electric accumulators and accessories, $975. **02,** 674.

Part 2, FND. Engineering Features.

Bricks; tests, etc. **04,** 3718.

Concrete mixing and placing. **98,** 620, 622; **99,** 751; **00,** 821, 823.

Concrete plant, arrangement of. **98,** 620.

Condensation, reducing. **03,** 2389.

Dampproofing. **03,** 2387.

Electric plant, installing of. **00,** 824.

Linings, rooms, etc. **04,** 3717.

Mixer, "gravity." **99,** 751; **00,** 821.

Mounting guns and carriages. **00,** 824.

Plant, approx. value of. **99,** 761; **00,** 827.

Plant, description of. **00,** 823.

Sea wall, stability of, movement of bar. **99,** 757; **00,** 822.

Submarine mines, preparation of material, novel features, operation, and testing. **98,** 616, 618.

Ventilation; hot-air circulation. **04,** 3713 (pl.); **04,** 3716 (pl.).

Waterproofing methods. **00,** 815, 816, 821, 824.

Exposed concrete. **04,** 3718.

Part 3, FND. Engineers.

Chief of Engineers. **R., 66,** 7; **67,** 7; **69,** 11; **70,** 16; **71,** 12; **72,** 9; **73,** 9; **74,** 10; **75,** 10; **76,** 11; **77,** 8; **78,** 10; **79,** 13; **80,** 25; **81,** 23; **82,** 19; **83,** 15; **84,** 21; **85,** 15; **86,** 15; **96,** 13; **97,** 13, 608; **98,** 18, 612; **99,** 19, 747; **00,** 17, 814; **01,** 17; **02,** 19.

Part 4, FND. Board of Engineers.

Constituted, 1882, to consider and report upon the condition of fortifications, and what number, if any, could be dispensed with. **R., 82,** 418. **Rs., 90,** 7; **93,** 15.

Part 5, FND. Engineers in Charge.

Capt. S. M. Mansfield, 1866–67.
Maj. D. C. Houston, 1867–70.
Maj. G. K. Warren, 1870–74.
Capt. A. H. Holgate, 1870.
Maj. J. W. Barlow, 1875–83.
Lt. Col. W. McFarland, 1883–86.
Lt. Col. D. C. Houston, 1886.
Maj. S. S. Leach 1896–1901.
Maj. C. F. Powell, 1902.

Part 6, FND. Assistants.

Lt. W. J. Barden, 1897–1900.
Lt. E. H. Schulz, 1900–02.

Part 7, FND—

FORTS AND BATTERIES.

Part 8, FND. New London Harbor, Conn.—Fort Trumbull, at "Fort Point."

1838. Work begun on casemated work. **80,** 25

1848. Work completed. **82,** 19.

1866. Care of fort keeper. **66,** 7.

1867. Care and preservation. **67,** 7.

1869. Repointing the parade wall. **69,** 11.

1870. Modification plans for twelve 15-inch guns or equivalent rifles. Est. cost, $58,000. Minor work. **70,** 17.

1874. $25,000 app. Minor repairs. **74,** 11.

1875. $20,000 app. Modification work begun. Work on north exterior battery. **75,** 10.

1876. North exterior battery completed, except setting platform irons and placing the magazine lamps. **76,** 11.

1877-79. Care and preservation. **77,** 8; **78,** 10; **79,** 13.

1880. History of fort; care and preservation. **80,** 25.

1881. Repairs to recess and embrasure arches parapet, and roads. **81,** 24.

1882. Preservation and repairs. **82,** 19.

1883. Work on sea wall. **83,** 16.

1884. History and description; work on sea wall. **84,** 21.

1885. Drainage work. **85,** 15.

1886. History and description. **86,** 15.

1898. Two 15-inch S. B. guns mounted. **98,** 612.

1899. Sewer laid by city of New London. **99,** 747.

1900. Description of fort. **00,** 814.

1902. Repairs to oil engine electric-power plant. **02,** 670.

Part 9, FND. New London Harbor, Conn.—Battery at Fort Griswold, Groton, Conn.

1840. This barbette earthen work begun. **80,** 26.

1870. Modification plans prepared for nine 15-inch guns. Est. cost, $40,000. Work on shot beds. **70,** 17; **83,** 16.

1876. Survey made of the boundaries of the U. S. lands. **76,** 11.

1877. Merestones replaced. **77,** 8.

1878. Sea wall repaired; some fencing done. **78,** 10.

1879. Care and preservation. **79,** 14.

1880. History of fort. **80,** 26.

1882. Care and preservation. **82,** 20.

1884-86. History and description of work. **84,** 22; **86,** 16.

1898. $33.50 allotted for renewing coal bin and parapet steps; eleven 10-inch guns with their carriages removed from the work. **98,** 612.

1900. Description of fort; repairing retaining wall and parade. **00,** 814.

1901. $185 for care and preservation. **01,** 747.

1902. Repairs to ordnance sergeant's quarters. **02,** 670.

Part 10, FND. Temporary Defenses at Bridgeport, New Haven, New London, and Stonington.

1898. $20,000 allotted. Four 10-inch S. B Rodman guns mounted at Bridgeport, 6 at New Haven, and 1 at Stonington; 3 platforms for 15-inch S. B. guns prepared at New London. **98,** 616.

1899. $4,600 allotted. Batteries at the several places dismantled and guns and carriages stored; where the batteries were on private property the premises were restored where necessary. **99,** 760.

Part 11, FND. New Haven Harbor, Conn.—Fort Hale.

1866. Work begun about the close of the Civil War. Work on embankments, sluiceway setting 5 granite pintle blocks; 1 platform laid 6 embrasures cut and revetted, and drawbr. built. **66,** 8.

1867. Work completed, plant sold at auction, and fort placed in charge of a fort keeper. **67,** 7.

1869. Making and hanging a gate at entrance to reservation. **69,** 11.

1870. Repairs to sea wall br., and road. **70,** 17.

1871. Negotiations pending concerning the purchase of additional land. **71,** 12.

1872. Fort dismantled. **72,** 9.

1874. Fort abandoned. **74,** 11.

1878. Proj. to modify the sea front for modern ordnance and to make permanent bombproofs; est. cost, $23,600. **78,** 10.

1879. Care and preservation. **79,** 14.

1880. History of fort. **80,** 26.

1882. Importance of site. **82,** 20.

Part 12, FND. Emplacements for Two 12-inch Guns on Disappearing Carriages.

1896. Plans prepared. **96,** 13.

1897. $132,000 allotted. Work begun by contract; excavation completed. **97,** 609.

1898. Work delayed; time extended, and battery completed ready for armament by June 30, 1898. **98,** 612.

1899. $1,500 allotted. Installation of electric light and power plant completed. $2,500 allotted. One carriage received and mounted; 2 guns received. $2,470 allotted for preservation and repair. **99,** 747.

1900. $2,500 allotted. Guns mounted; battery completed and turned over to the Artillery May 12. $2,000 allotted for waterproofing. $2,500 allotted for alteration and repair; ironwork painted. **00,** 814.

1901. False slab ceiling installed; base ring releveled and reset. **01,** 748.

Part 13, FND. Two Emplacements for 10-inch Rifles, Disappearing Carriages, and a Mining Casemate.

1897. $10,000 allotted for the emplacements and $11,000 allotted for 1 mining casemate, both to be built under 1 contract. **97,** 609.

1898. $99,000 allotted for emplacements and $2,750 allotted for moving and mounting guns. Work under contract begun; 1 carriage mounted and work about half done; extension of time granted. Summary of work. **98,** 614.

1899. $2,500 allotted for emplacements; work nearly completed. $318.17 allotted for finishing the mounting of guns and carriages; completed. Mining casemate completed. $2,004 allotted for a battery-commander's range-finding station. $310 allotted for preservation and repair. **99,** 748.

1900. Battery-commander's station finished and battery transferred to the Artillery on Mar. 31. $250 allotted for repairs. **00,** 817.

1901. Casemate wired and minor repairs to battery. **01,** 749, 750.

Part 14, FND. Emplacements for Eight 12-inch B. L. Mortars.

1897. $110,000 allotted. Work begun, excavation finished, and concrete work in progress. $2,004 allotted for a battery-commander's range-finder station. **99,** 750.

1900. Battery completed; armament to be mounted by the garrison; battery-commander's station begun and completed; proposals for electric plant received. Summary of work. **00,** 818.

1901. $2,000 allotted. Battery completed; electric plant installed; 2 mortars and carriages mounted; transferred to Artillery Mar. 4, 1901. **01,** 750.

Part 15, FND. Emplacements for Two 10-inch B. L. Rifles on Disappearing Carriages, Model 1896.

1898. $100,000 allotted. Work begun and these emplacements nearly completed by June 25; résumé of work. $3,000 allotted for transporting guns. **98,** 619, 621.

1899. Guns and carriages received and mounted; electric light and power plant installed, and battery practically completed; searchlight temporarily installed. **99,** 759.

1900. Platforms covered with asphalt; slopes sodded, and minor work; battery transferred to the Artillery May 12. **00,** 816.

1901. $500 for sodding on slopes. **01,** 748.

Part 16, FND. Emplacement for a 4.7-inch R. F. Gun.

1898. $9 000 allotted. Work begun, gun and carriage mounted; work nearly finished. **98,** 622.

1899. Work postponed in view of the probable necessity of raising the gun about 2′ on account of change in the type of emplacements near by. **99,** 760.

1900. Gun mounted work completed, and formally transferred to the Artillery, Mar. 31 1900. **00,** 820.

Part 17, FND. Emplacements for Two 8-inch B. L. Rifles on Barbette Carriages (15-inch S. B., Converted).

1898. $65,000 allotted. Work begun and platform nearly completed. Summary of work. **98,** 622.

1899. $12,100 allotted. Battery completed except mounting guns. Work on sea wall. **99,** [illegible].

1900. Interior floors concreted. Terreplein graded; guns and carriages not yet mounted. **00,** 822.

1901. Minor repairs made. **01,** 752.

Part 18, FND. Two Emplacements for 6-inch R. F. Guns on Disappearing Carriages.

1899. $50,000 allotted. Work begun; excavation in progress. **99,** 750.

1900. Work practically completed, except consolidation of slopes and electric lighting. Carriages on hand. **00,** 819.

1901. $2,000 allotted for searchlight; electric system installed and tested; entire battery transferred to Artillery Mar. 4, 1901. **01,** 750.

Part 19, FND. Two Emplacements for 8-inch B. L. Rifles on Disappearing Carriages, and Two Emplacements for 5-inch R. F. Guns on Balanced Pillar Mounts.

1899. $75,000 allotted for emplacements. Work begun, dock completed, plant installed, and work carried up to ceiling level. **99,** 751. Five-inch emplacements; $11,600 allotted. Work begun and nearly completed; mounts not received. **99,** 751.

1900. Two carriages and 1 gun mounted; platforms asphalted; electric-light plant installed. Five-inch emplacements—Two carriages mounted; both batteries completed and ready to turn over to the Artillery; $1,650 allotted for repair and preservation. **00,** 821.

1901. Electrical system maintained and painting of ironwork; batteries transferred to troops Feb. 18, 1901. $1,500 allotted for care and preservation for waterproofing drainage, etc. **01,** 752.

Part 20, FND. Emplacements for Two 12-inch B. L. Rifles on Disappearing Carriages, Model 1897; Two 10-inch B. L. Rifles on Disappearing Carriages, Model 1896; and Three 6-inch R. F. Guns on Disappearing Mounts.

1899. Twelve-inch and 10-inch emplacements—$220,000 allotted. Work begun. excavation completed, and concrete work in progress. **99,** 752. Six-inch emplacements—$78,000 allotted, work begun, excavation in progress. **99,** 752.

1900. Ten-inch emplacements completed and guns and carriages mounted; 12-inch emplacements well advanced and 6-inch emplacements expected to be completed by Oct. 1. Summary of work. $2,000 allotted for preservation and repair. **00,** 823.

1901. Entire battery for 10-inch and 12-inch emplacements completed, chain ammunition lifts placed, temporary range-finder's station and tide gauge built. At 6-inch emplacements lifts placed carriages mounted; batteries transferred to Artillery Mar. 7, 1901. **01,** 754.

Part 21, FND. Emplacements for Two 5-inch R. F. Wire-wound Guns, with Parados.

1899. $39,630 allotted. Work begun, concrete work nearly completed; mounts not received. $2,195 allotted for repair to sea wall; work in progress. **99,** 757.

1900. Plans changed, emplacements completed, except mounting guns not yet received; parados finished and $1.060 allotted for repairs to sea wall, etc. **00,** 822.

1901. $8,000 allotted for strengthening sea wall; $11,810 allotted for care and preservation. **01,** 753.

Part 22, FND. Emplacements for Two 5-inch R. F. Wire-wound Guns.

1900. $14,000 allotted. Battery begun and completed, except mounting armament, electric wiring, and sodding slopes. **00,** 822.

1901. Electric wiring installed, slopes sodded battery transferred to Artillery Feb. 18, 1901. $100 allotted for care and preservation. **01,** 752.

Part 23, FND. Emplacements for 5-inch Wire-wound Gun.

1900. $6,500 allotted. Work nine-tenths completed. **00,** 820.

1901. Work finished; electric wiring installed; transferred to Artillery, Mar. 4, 1901. $150 allotted for care and preservation. **01,** 751.

Part 24, FND. Emplacements for Eight 12-inch B. L. Steel Mortars.

1901. $115,000 allotted. Material purchased track laid, excavation begun. $400 allotted for care and preservation. **01,** 754.

Part 25, FND. Emplacements for Two 6-inch R. F. Guns.

1901. $25,000 allotted. **01,** 748.

Part 26, FND. Various Sites.

Site 1. **1902.** Bulkhead built on south shore: wharf repaired; power house built; at 8-inch battery steam-heating plant installed; repairs. **02,** 670. $1,700 allotted for searchlight; $750 allotted for 3 base stations; $200 allotted for wharf. **02,** 671.

Site 2. **1902.** Electric installation at 3 batteries completed; transferred to Artillery, Dec. 7, 1901. **02,** 671. Repairs to heating system. **02,** 671. Mortar battery constr. and electric installation completed, base rings set, survey for dynamite-gun emplacements made; work on post-lighting system completed, fire-commander's station partly built. **01,** 672, 673. Searchlights and accessories received. **01,** 673. $19,200 allotted for range-finding station; $2,450 allotted for searchlights; $9,020 allotted for post-lighting system; $620 allotted for care and preservation; $12,275 allotted for searchlights for H. defenses. **02,** 674.

Site 3. **1902.** Position-finding station transferred to Artillery; bank riprapped; fire-commander's station moved back; battery magazine lined. **02,** 674. Steam-heating plant put in to reduce condensation; parapet of 10-inch battery sodded; work on new 6-inch battery in progress: 4,725 tons granite placed in sea wall; temporary power house for operations of searchlight built. **02,** 675. $7,960 allotted for fire-commander's station; $7,362 allotted for battery-commander's station; $3,840 allotted for searchlights; $783.02 allotted for care and preservation; $500 allotted for supplies for seacoast defenses. **02,** 676.

Site 4. **1902.** Steam-plant alterations and imp. of drainage at mortar battery made; minor repairs at 10-inch battery; foundation of fire-commander's station laid; temporary power house for searchlights built; repairs to steam plant at mortar battery; arrangements made for 2 additional searchlights at south reservation; $4,800 allotted for fire-commander's station; $2,425 allotted for searchlights; $7,260 allotted for searchlights for H. defenses. **02,** 677

Site 5. **1902.** Repairs, etc. **02,** 678.

Part 27, FND. Miscellaneous.

Protection of dynamite battery. **1901.** $66,000 allotted. Materials delivered. **01,** 755.

Care of electric plants. **1901.** $2,500 allotted for repairs. **02,** 678.

Part 28, FND. Preservation and Repairs.

1899. $2,180 allotted. Electric plant cared for; dismounted guns from temporary batteries disposed of; and minor work. **99,** 758.

1900. $800 allotted for supplies for seacoast defenses. Repairs made to the several electrical plants. **00,** 826.

1901. $900 allotted. **01,** 756.

Part 29, FND. Range and Position Finder Station.

99, 749, 750; **00,** 818.

1901. $7,000 allotted. Practically completed. **01,** 748.

Part 30, FND. Sea Walls and Embankments.

1901. $12,000 allotted. Constr. sea wall; 330 l. f. built. $1,900 allotted. Care and preservation. **01,** 749. $2,600 allotted for bank revetment; no work done. **01,** 752.

Part 31, FND. Sites.

1898. $5,650 allotted for purchase of 3 tracts, about 60 acres. Condemnation proceedings instituted to acquire another site of about 225 acres. **98,** 623.

1899. $175,000 allotted. Site acquired. **99,** 761.

1900. $50 allotted for services in making abstracts of title to land already acquired. **00,** 826.

Part 32, FND. Submarine Mines.

1898. $29,000 allotted. Mines planted in Stonington, New London, and New Haven Hs. **98,** 616. $1,150 allotted for searchlight. **98,** 621, 623.

1899. Mines unloaded as removed and dynamite stored; orders received to complete the dismantling of the systems and final disposition of the material; work completed. $300 allotted for electric-light plant and operating searchlight; supplies purchased and machinery cared for. **99,** 757, 760.

1900. $500 allotted for storing and caring for mining material, and building a partition wall in mining casemate to separate battery from instrument room. **00,** 826.

1901. $50 allotted. Inspection of torpedo materials. **01,** 756.

FNF. NEW YORK, N. Y., FORTIFICATIONS.

(Note.—Reports on these works from 1903 to 1912 are of a general character only. See the first 15 pages of each annual report from 1903 to 1912. See also the Note on p. 1793 of this index.)

(See also Misc. 171 on p. 2134 of this index.)

Part.	Title.	Period.
1	Contracts	1883–1902
2	Engineering features	1892–1904
3	Engineers—Chief of Engineers	1866–1908
4	BE	1882–1890
5	In charge	1866–1908
6	Assistants and civilian electricians	1880–1902
7	Forts, etc.—Operations, allotments, etc	1812–1912
8	Southern entrance—Fort Lafayette	1812–1878
9	Fort Hamilton	1824–1886
10	Mortar battery	1871–1886
11	Redoubt	1866–1871
12	Governors Isld	1831–1886
13	Fort Columbus	1866–1878
14	New barbette battery	1875
15	Castle William	1866–1870
16	South battery	1867–1874
17	Bedloes Isld	1841–1886
18	Staten Isld., N. Y.—Battery Hudson	1841–1901
19	Fort Wadsworth	1847–1886
20	South Cliff battery	1858–1886
21	Fort Tompkins	1858–1886
22	North Cliff battery	1862–1886
23	New casemated battery	1866–1870
24	Glacis mortar battery	1871–1886
25	South mortar battery	1872–1886
26	Glacis gun battery	1872–1886
27	Two-gun battery	1883–1886
	Southern entrance—	
28	Five-gun battery	1891–1899
29	Two 2-gun batteries for 10-inch guns	1897–1899
30	Battery, three 10-inch and four 12-inch guns	1897–1900
31	Two emplacements, 8-inch B. L. rifles, modified 15-inch gun carriages	1898–1899
32	Twelve-inch emplacements, Battery Richmond	1898–1899
33	Twelve-inch emplacements, Battery Hudson	1898–1900
34	Temporary batteries	1898
35	Rapid-fire gun	1898
36	Two emplacements, 15-pounder R. F. guns	1899
37	Two emplacements, 6-inch R. F. guns, pedestal mounts	1899
38	Two emplacements, 6-inch guns, disappearing carriages	1899–1900
39	Miscellaneous defense work	1901–1902
40	Sandy Hook, N. J	1857–1885
41	Mortar battery No. 1 (with ditch defenses)	1890–1900
42	Gun-lift battery No. 1	1891–1899
43	Ten-inch battery	1897–1899
44	Five-inch R. F. battery	1897–1900
45	Pneumatic-gun battery	1898–1900
46	Six-inch R. F. battery	1898–1899
47	Fifteen-pounder R. F. emplacement	1899–1900
48	Miscellaneous defenses	1901–1902
49	Long Isld.—Seven-gun battery	1893–1900
50	Twelve-inch mortar battery	1898–1900
51	R. F. guns	1898–1899
52	Twelve-inch battery No. 1	1898–1900
53	Twelve-inch battery, Stone Fort	1899–1900
54	Six-inch battery	1899–1900
55	Two 15-pounder R. F. guns	1899–1900
56	Miscellaneous defenses	1900–1902
57	Eastern entrance—Fort Schyuler, East R	1833–1885
58	Fort at Willets Point	1863–1886
59	Gun battery, south side of entrance	1891–1900
60	Battery for sixteen 12-inch mortars	1891–1900
61	Mortar battery, eight 12-inch modern mortars	1897–1899
62	Two emplacements, 10-inch rifles, disappearing carriages	1897–1899
63	Emplacement 1, 12-inch rifle, disappearing carriage	1897–1899
64	Platforms for target practice	1896–1900
65	Two emplacements, 5-inch R. F. guns	1898–1900
66	Two emplacements, 15-pounder R. F. guns (south)	1899–1900
67	Two emplacements, 15-pounder R. F. guns (north)	1899–1900
68	Two emplacements, 5-inch R. F. guns (north)	1899–1900
69	Emplacement 2, 12-inch rifle (north)	1899–1900
70	Two emplacements, 5-inch R. F. guns	1900–1901
71	Two emplacements, 6-inch R. F. guns	1901–1902
72	Miscellaneous works (south)	1901–1902
73	Miscellaneous works (north)	1901–1902

New York, N. Y., Fortifications—Continued.

Part.	Title.	Period.
74	Preservation and repairs	1897–1902
75	Range and position finders	1896–1902
76	Searchlights	1901–1903
77	Sea walls and embankments	1889–1911
78	Sites	1892–1902
79	Submarine mines	1891–1902
80	Supplies	1901–1902
81	Mastic works—Governors Isld	1880–1882

Part 1, FNF. Contracts.

1883. Sea wall, $18.72 per l. f. **83,** 385.

1889. Sea wall, concrete foundation, 375 c. y., $14.70 per c. y.; wall, 1,450 c. y., $15 per c. y.; and dowels, 25¢ per pound. Embankment, 24,000 c. y., 22½¢ per c. y. **89,** 461. Riprap, 9,050 tons, $1.50 per ton; capping stone, 980 l. f., $7 per l. f. Embankment, 35,000 c. y., 40¢ per c. y. **89,** 458.

1891. Sea wall, 1,000 c. y. of foundation, $11 per c. y.; 1,510 l. f. wall, $19 per l. f.; 43,000 c. y. filling, 29¢ per c. y. **91,** 527.

1897. Small broken stone, 5,000 c. y., $1.07 and $1.29 per c. y.; 100 c. y. fine sea-washed silica, $2.50 per c. y. Rosendale cement, 12,000 barrels, 74.8¢ per barrel. **97,** 617. Concrete battery for three 10-inch guns, $78,202.50. **97,** 627.

1898. Rosendale cement, 18,000 barrels, 66.6¢ per barrel. Riprap stone, 47,500 tons, $1.19 per s. t. Broken stone, $1.04 per c. y. **98,** 633.

1900. Portland cement, 25,000 barrels, $1.99 per barrel. Broken stone, 21,000 c. y., 84¢ per c. y. Sand, 11,000 c. y., 34¢ per c. y. **00,** 836.

1901. Rock, 79¢ per c. y. American Portland cement, $1.532 per barrel, in bags. **01,** 766.

1902. Building sea wall, $10.75 per l. f., 28¢ per yard for material. **02,** 684. Atlas Portland cement, $1.10 per barrel. **02,** 686. Trap rock (broken), 72¢ per c. y. **02,** 687. Trap rock (broken), 84¢ per c. y. **02,** 689. American Portland cement, $1.47 per barrel. **02,** 689. Furnishing steel doors, shutters, gratings, flues, etc., $1,879. **02,** 689. American Portland cement, $1.63 per barrel. **02,** 692. Broken trap rock, 89¢ per c. y. **02,** 692.

Part 2, FNF. Engineering features.

Ammunition for a gun lift, handling of. **93,** 610.

Ammunition lifts, test of. **97,** 619.

Anchor bolts, method of setting. **94,** 453.

Battery, 10-inch, cost in detail. **97,** 616, 621.

Ceilings, linings of. **03,** 2390 (pl.).

Concrete in place, cost of. **92,** 5; **93,** 602, 605, 609; **94,** 458; **00,** 835, 837. Mixing, description. **97,** 620. Surfaces of, coloring. **04,** 3720.

Construction costs, 12 inch empl. **01,** 765.

Dampproofing—various methods. **03,** 2390, 2396 (pl.). Walls. **03,** 2390, 2396 (pl.). Chambers. **03,** 2393, 2396 (pl.). Cartridge rooms. **03,** 2398 (pl.). Magazines. **04,** 3719.

Electric-conduit system, cost. **00,** 837.

Electric-light plant description. **93,** 611.

Electricity, installation. **04,** 3721.

Embankments, cost per c. y. in place. **92,** 603.

Embankment, methods of placing sand. **93,** 605.

Excavation, sand, cost of, by hand and by grapple. **93,** 603.

Firing, experimental, result on concrete. **93,** 612, 614.

Fire, test of rapidity of. **97,** 619.

Gun, 12-inch, method of mounting. **93,** 615; **94,** 453.

Gun-lift mechanism, test of. **93,** 613.

Leaks, stopping. **03,** 2391, 2396 (pl.).

Materials, cost. **93,** 602, 605; **94,** 454, 458; **97,** 763, 769.

Mortar platforms, method of excavation for foundation. **94,** 450.

Pavements, cost of. **97,** 616.

Plant, arrangement of. **93,** 605; **99,** 763, 766, 774.

Platforms, settlement of. **97,** 612.

Quoins, granite, cost of. **97,** 616.

Sand, drifting; cinder layers to prevent. **01,** 920.

Stone (large) in place, cost of. **92,** 5.

Torpedo shed, description and detailed cost. **93,** 617; **94,** 448.

Ventilation various methods. **03,** 2393, 2396 (pl.).

Walls, counterscarp and gallery; a smooth and apparently waterproof surface, securing. **93,** 606

Whitening (methods and advantages). **01,** 920.

Waterproofing and cost of. **00,** 828, 829, 831, 839. Details of various methods. **01,** 917. Laying felt. **01,** 919. "Without leaks." **01,** 919.

Water-supply system. **93,** 613.

Part 3, FNF. Engineers.

Chief of Engineers. **R., 66,** 8, 11; **67,** 7; **68,** 11; **69,** 11; **70,** 17; **71,** 12; **72,** 10; **73,** 9; **74,** 11; **75,** 11; **76,** 11; **77,** 8; **78,** 10; **79,** 14, 233; **80,** 27, 292; **81,** 25, 385; **82,** 20; **83,** 16; **84,** 22; **85,** 16; **86,** 5, 17; **87,** 5; **89,** 6, 458, 459; **90,** 5, 381; **91,** 7, 9, 525; **92,** 5, 12, 457; **93,** 6, 599; **94,** 7, 449; **95,** 7, 504; **96,** 8, 473; **97,** 13, 610; **98,** 18, 624; **99,** 20, 762; **00,** 19, 827; **01,** 19; **02,** 20; **03,** 9, 14, 16; **04,** 5, 9, 10; **05,** 5; **06,** 5; **07,** 5; **08,** 9; **9,** 10; **10,** 12; **11,** 8; **12,** 7.

Part 4, FNF. Board of Engineers.

Constituted, 1882, to consider and report upon the condition of fortifications, and what number, if any, could be dispensed with. **R., 82,** 408. **Est. 87,** 11; **90,** 6.

Part 5, FNF. Engineers in Charge.

W. P. Trowbridge, U. S. agent, 1866.
Lt. Col. H. L. Abbot, 1866-86.
Capt. F. Harwood, 1866.
Lt. Col. J. C. Duane, 1866-68.
Maj. F. E. Prime, 1866.
Capt. C. N. Turnbull, 1866.
Maj. N. Bowen, 1866-69.
Lt. Col. J. Newton, 1866-77.
Col. J. G. Barnard, 1866-67.
Col. Q. A. Gillmore, 1867-86.
Capt. J. Mercer, 1877-78.
Col. H. W. Benham, 1878-82. **R., 79,** 234; **80** 293.
Col. G. L. Gillespie, 1883-97.
Capt. J. C. Post, 1883.
Lt. Col. C. B. Comstock, 1886.
Lt. Col. W. MacFarland, 1886.
Col. D. C. Houston, 1886-93. **R., 92,** 459.
Lt. Col. W. R. King, 1891-95.
Lt. Col. H. M. Robert, 1893-96.
Lt. T. H. Rees, 1893.
Lt. R. McGregor, 1895.
Maj. W. T. Rossell, 1896.
Maj. J. G. D. Knight, 1896-1900.
Maj. H. M. Adams, 1896-1900.
Lt. Col. W. Ludlow, 1897-98.
Lt. Col. W. H. H. Benyaurd, 1900.
Maj. W. L. Marshall, 1900-08.
Maj. J. G. D. Knight, 1901.
Maj. Wm. M. Black, 1901-

Part 6, FNF. Assistants and Civilian Electricians.

Lt. E. Griffin. **R., 80,** 293.
Lt. H. Taylor, 1891-92.
Lt. J. G. Warren, 1892-94.
Lt. T. H. Rees, 1893.
Lt. W. P. Craighill, 1894-96.
Lt. R. McGregor, 1894-99.
Lt. R. R. Raymond, 1897-99.
Lt. J. F. McIndoe, 1898-1901.
Lt. E. R. Stuart, 1898-99.
Lt. J. J. Morrow, 1899-1900.
Lt. J. A. Woodruff, 1898-1901.
Lt. W. L. Guthrie, 1902.

Civilian electricians. **1902.** $1,200 allotted for pay of electrician. **02,** 680. $7,020 allotted for pay of electrician, steam engineers, and stokers. **02,** 687.

Part 7, FNF—

FORTS AND BATTERIES.

Part 8, FNF. Southern Entrance—Fort Lafayette.

1812. Work begun. **80,** 29.

1866. Important modification required. **66,** 10.

1868. Test borings on proposed site of new work. Fort injured by fire in December, 1868. **68,** 12.

1878. Proj. for heavy armament; est., $784,212 **78,** 13.

Part 9, FNF. Fort Hamilton and Additional Batteries.

1824. Work begun. **80,** 29.

1866. Work on north, south, and small traverse magazines; setting pintle and traverse stones, traverse irons, and pintles; breast-height wall and earth in parapet. Traverse magazines 1, 2, and 4 completed; 3 and 5 suspended. **66,** 10.

1867. Work on south magazine; taking up platforms to make room for traverse magazines; revetment and platform flags; traverse stones rebedded; embankment and minor work. Condition of work. **67,** 9.

1868. One traverse magazine lengthened, 5 nearly completed. The north and south magazines now completed, except minor work Over 2000 feet drain work done. **68,** 12.

1869. North and south magazines nearly completed, 9 magazine traverses finished; 3,464 l. f. drain built; 991 l. f. sea wall rebuilt; 3,407 sq. y slopes repaired. Est. cost of additional batteries for heavy guns, $135,000. **69,** 12.

1870. Completion of north and south magazines and traverse magazines; repairs made to slopes and parapet; terreplein and public road graded; repairs to sea wall and drainage. **70,** 18.

1871. $25,000 app. Work begun on cofferdam, 483′ long, on water battery 1. **71,** 14.

1872. $40,000 app. Sea wall ready for coping and in rear filled with earth to 2′ below top. **72,** 11.

1873. $40,000 app. Sea wall of battery 1 completed; magazines 1 and 2 nearly finished; work on magazines 3 and 4; 8,464 c. y. of earth placed in parade. **73,** 10.

1874. $26,000 app. Battery 1—magazines 1, 2, 3, and 4 completed and sodded. Drain placed, terreplein graded, and parapet raised to proper level. 15-inch gun battery—5-inch pintles taken out and replaced with 6-inch ones. **74,** 13.

1875. $10,000 app. Battery 1—2 wooden platforms and 6 stone platforms nearly finished, raising breast-height wall. **75,** 13.

1876. Battery 1—platforms and breast-height wall completed; parapet and end of traverse raised and rear slopes sodded. **76,** 14.

1877–78. Repair of gates and slope. **77,** 10; **78,** 12.

1881. Waterproofing terrepleins and casemates; repair of slopes and fences. **81,** 28.

1882. Waterproofing terrepleins and casemates; drainage work, sea wall, and minor repairs. **82,** 24.

1883. Work on relaying brick pavements, wooden br., drainage, slopes, and buildings. **83,** 20.

1884. Repair of slopes, chimneys, drains, etc. **84,** 25.

1885. Repair of platforms, breast-height, sustaining and sea wall; placing additional traverse stones in platforms, relaying pavements, and replacing stone flagging of parade. **85,** 18.

1886. 1,190 c. y. riprap stone placed against sea wall; hanging 12 magazine doors; setting pintles in platforms. **86,** 19.

Part 10, FNF. Mortar Battery, Fort Hamilton.

1871. Work begun. **80,** 29.

1872. Funds derived from general app. for mortar batteries. Six traverse magazines, including 3 service magazines, built; terreplein and parapet also completed except draining and sodding. **72,** 11.

1873. Earth placed on magazines and traverses and sodded; exterior and interior slopes graded and sodded; drainage begun. **73,** 11.

1874. Main drain completed, exterior slopes sodded, 3 magazines supplied with doors, 5 wooden platforms laid, and concrete foundations for the remaining 8 put down. **74,** 13.

1875. Seven wooden platforms placed and exterior slope partly sodded. **75,** 13.

1876. Drainage. Terreplein graded and soil placed on slopes. **76,** 14.

1886. Furnishing and hanging 3 exterior doors. **86,** 20.

Part 11, FNF. Fort Hamilton and Redoubt.

1866. Condition to be considered by a BE **66,** 10.

1867. Embrasures cut down and shot furnaces removed. Condition of work. **67,** 9.

1868. Part of counterscarp wall rebuilt; over 2,000′ of drain work completed; minor work on buildings. **68,** 13.

1869. Altering embrasures on the east and north fronts; pointing scarp and counterscarp walls and repairing slopes; and minor repairs. **69,** 12.

1870–71. Repairs; and embrasures altered in officers' quarters. **70,** 18; **71,**13.

Part 12, FNF. Defenses of Governors Island.

1831. Fortifications on Governors Isld. begun **80,** 28.

1879. Est. for a sea wall 1,800 l. f. long, 8′ high, $96,000; including wall on west shore, cost, $40,000. Extracts from letters from Maj. Gen. Hancock, Capt. J. P. Sanger, Col. and Surg. Cuyler, and Col. Benham in reference to explanation of the ests. for sea wall. **79,** 15, 233; **80,** 28, 293.

1881. Scarp wall color-washed and terreplein covered with asphalted felting. Sea wall est. **81,** 26, 303.

1882. Br. across ditch at Fort Columbus repaired. **82,** 22.

1883. Exterior slopes of southwest bastion of Fort Columbus repaired and resodded; first and second interior galleries at Castle Williams partly rebuilt, repaired, and painted. **83,** 18.

1884–86. Preservation and repair. **84,** 24; **85,** 17; **86,** 18.

Part 13, FNF. Governors Island—Fort Columbus.

1866. Flagging the walks of the parade; repairing the pump drain, and relaying the platform around the pump. **66,** 9.

1867. Work on flagging the walks and curb of parade; removing old cobblestone covering of postern and ramp, and placing Belgian pavement; general repairs and minor work. **67,** 8.

1868. Pointing the scarp; relaying flagging; drainage work; repairing slopes, roads, and glacis and minor work. **68,** 11.

1869. Repairing glacis, slopes, roads, and banks, drawbr., magazines; and minor repairs. Est., earthen battery for heavy guns, $104,000. **69,** 12.

1871. Eight traverse magazines built in new battery; work on parapet, excavation for the terreplein, road, and remaining 8 magazines. **71,** 13.

1872. Six shot beds built and 8 more begun; in new barbette battery, 6 magazines coated outside with Portland cement; parapet completed and terreplein reduced to proper level. **72,** 10.

1873. Fifty-four shot beds built and 1,027 l. f. sea wall laid. **73,** 10.

1874. Replacing draw floor in drawbr. **74,** 12.

1875. Repairing drains. **75,** 12.

1876–77. Repairing drawbr. and wharf. **76,** 13; **77,** 9.

1878. Repairing slopes, etc. **78,** 12.

Part 14, FNF. Governors Island—New Barbette Battery at Fort Columbus.

1875. Repair of magazine doors; surface drain and 8 temporary magazine doors built. **75,** 12.

Part 15, FNF. Governors Island—Castle Williams.

1866. Steps of the towers repaired, 255 sq. f. of flagging laid. **66,** 9.

1867. Tower steps finished; renewing the 3 galleries of communication of the casemates; repairing magazine doors and buildings, etc. **67,** 8.

1868. Repairing galleries, doors, and embrasure shutters; 10 casemates repaved; repairing mastic covering of terreplein; and minor work. **68,** 12.

1869. Brick floors of ground tier relaid; repairing casemates of upper tier; galleries and railing of second and third tiers and terreplein of barbette tier and magazines repaired. **69,** 12.

1870. Covering the terreplein with mastic. **70,** 18.

Part 16, FNF. Governors Island—South Battery.

1867. Slight repair of scarp walls. **67, 8.**

1868. Flagging of parade taken up and relaid; epair of sally port and drains. **68, 12.**

1870. 150′ dry stone sea wall built. **70, 18.**

1874. Extension of permanent drain to beach. **74, 12.**

Part 17, FNF. Bedloes Island—Fort Wood.

1841. Work begun. **80, 28.**

1867. Drainage work. Isld. quarantined because of cholera. **67, 8.**

1868. Repairing exterior walls and coping of magazines; coping of parade wall; mason work of steps, posterns, and brick walls of barracks. **68, 12.**

1869. Pavement in sally port relaid and masonry of sea wall pointed. Modification of exterior earthen battery for heavy guns cost $3,200. **69, 12.**

1870. Two magazines supplied with conductors and connections for the rods. **70, 18.**

1871. In the new water battery, 5 traverse magazines built, parapet built entire length of battery, and terreplein raised to the proper height **71, 13.**

1872. $17,000 app. Entrances to magazines in exterior water battery completed; part of parapet raised to proper height. **72, 11.**

1873. Raising parapet, pointing and cementing magazines of the exterior battery. **73, 10.**

1874. Grading and sodding magazines, raising parapet, and drainage. **74, 12.**

1875. Five temporary magazine doors built and magazines covered with earth. **75, 12.**

1876. Terreplein graded and parapet filled in on the exterior water battery. **76, 13.**

1877. Site selected for pedestal of the Statue of Liberty presented by citizens of the French Republic. **77, 10.**

1883. Minor repairs. Erection of the Statue of Liberty begun. **83, 20.**

1884. Minor repairs. Concrete foundation for the Statue of Liberty completed. **84, 25.**

1885. Doors provided for 3 magazines. Pedestal for the Statue of Liberty completed; height, 93′ 8″ above m. l. w. **86, 18.**

1886. Placing magazine doors. Statue of Liberty being placed. **86, 19.**

Part 18, FNF. Staten Island—Battery Hudson.

1841. Work begun. **80, 31.**

1866. Repairs to slopes and minor work. **66, 11.**

1867. Catch basin and trap built; drainage. **67, 10.**

1868. Cleaning drains and traps; cutting grass. **68, 13.**

1869. Entire slope in rear of battery washed into terreplein, slope repaired, lining with wood begun on the two principal magazines; modification of battery for heavy guns and an earth extension; est. cost, $62,000. **69, 13.**

1870. Furring with wood the 2 principal magazines and repair of slopes; building a dry stone wall over the casemated arch of the experimental casemate target. **70, 19.**

1871. $16,000 app. Two service magazines built. Excavation to form the rear slope; filling over the magazines. **71, 15.**

1872. $17,000 app. Platform and parapet for King's carriage and entrance retaining walls built. In Battery Hudson extension—principal magazines and rear slope sodded; excavation for terreplein; earthwork of 2 traverse magazines formed; modification approv. **72, 12.**

1873. $29,000 app. Old lighthouse removed, three 10-inch guns dismounted, and platforms removed; one 15-inch front pintle platform nearly finished. In the extension—earthwork of 2 traverses and the retaining wall changed to a more gentle slope. **73, 12.**

1874. $13,000 app. Removal of 6 guns and platforms of old armament; 5 front pintle platforms placed. In the extension—5 timber platforms with high traverse rails laid. **74, 14.**

1875. $15,000 app. Work on earth cover of n. and s. principal magazines finished; seven 200-pounder Parrot rifle guns dismounted and old 10-inch platforms and breast-height wall removed; center pintle platforms replaced with front pintle platforms. In extension—5 timber platforms removed; work on breast-height wall, bombproof shelter, and retaining wall. **75, 15.**

1876. Work on breast-height wall and platforms. In extension—work on breast-height wall, bombproof, and retaining wall, platforms. **76, 15.**

1877. Work on platforms and parapet. In the extension—work on the parapet; outer traverse rails laid on five 15-inch gun timber platforms; work on earthen slopes. **77, 12.**

1878. Repair of slopes. **78, 14.**

1879. 250′ of fence built; repairs. **79, 18.**

1880–85. Care and preservation. **80, 31; 81, 30; 82, 27; 83, 24; 84, 28; 85, 21.**

1886. Two wooden front pintle platforms for 8-inch converted rifles built and guns mounted. **86, 22.**

Part 19, FNF. Staten Island—Fort Wadsworth (Formerly Fort Richmond).

1847. Work begun. **80,** 30.

1866. Work on granite walls; 16 floor girders placed, filling carried up to the height of exterior walls, and ditch three-fourths excavated. **66,** 10.

1867. Guardhouse and 2 cisterns finished, ditch excavated, and 2 sluiceways completed. **67,** 9.

1869. 330 c. y. earth, washed from main slope into road, removed. **69,** 12.

1870–71. Repair of slopes in rear of work. **70,** 19; **71,** 14.

1874. Replacing old pintles with new 4-inch ones in the 6-inch barbette guns' platforms. **74,** 13.

1875. $5,000 app.; no work. **75,** 13.

1876. Torpedo work and repair of storeroom roofs. **76,** 14.

1878. Painting ironwork in embrasures; minor work. **78,** 13.

1879. Wooden approach to drawbr. built; iron railing and portcullis painted; slopes repaired. **79,** 16.

1880–81. Ten-inch S. B. guns on first tier replaced with 8-inch rifles. **80,** 30; **81,** 29.

1882. Arch built over reservoir; repair of masonry of sea wall; stone steps built at the wharf; painting barbette railing, ironwork of embrasures portcullis, etc.; 2 concrete shot beds built on parade. **82,** 25.

1883. Sea wall repaired; stationary part of drawbr. renewed; minor work. **83,** 21.

1884. Painting guardhouse and magazine roofs. **84,** 26.

1885. Replacing old pintles with new 4-inch pintles with keys; resodding revetment on top of breast-height wall, painting storeroom roof, etc.; minor repairs. **85,** 19.

1886. Repointing gun platforms and breast-height wall, and a rough, low retaining wall built halfway down the long slope. **86,** 20.

Part 20, FNF. Staten Island—South Cliff Battery.

1858. Work begun. Importance. **80,** 33.

1866. Slopes in rear of terreplein formed and sodded; n. end battery finished; work on s. end of battery. **66,** 11.

1867. Main slopes completed; new magazine constructed; minor work. **67,** 10.

1868. Work on roads, gutters, and slopes. **68,** 14.

1869. Repair of slopes; platform 5, injured in experimental firing, repaired; est., proposed modifications, $17,000. **69,** 13.

1870. Platform damaged by experimental firing repaired; repair of parapet; sodding slopes. **70,** 19.

1871. Slopes repaired and cesspools cleaned. **71,** 5.

1873–74. Care and preservation. **73,** 12; **74,** 15.

1875. Bluestone revetment above breast-height wall and part of old armament removed preparatory to beginning modifications. **75,** 15.

1876. Proj. modified. Work on traverse magazine front wall; removal of platforms; excavation for drains. Eight guns mounted. **76,** 16.

1877. Est., completion, according to approved plans, $37,100. Minor work and repairs. **77,** 12.

1878. Minor repair of slopes, etc. **78,** 15.

1879. Repair of roof of traverse magazine and slopes. **79,** 18.

1882. Retaining wall built near entrance to principal magazine; large slope in rear of battery repaired and regraded. **82,** 20.

1883. Repair of slopes. **83,** 25.

1884. Repair of doors, slopes, and gun platforms, etc. **84,** 30.

1885. Replacing 5-inch pintles with new 6-inch pintles; placing 3 inner traverse circles; laying floor; painting doors; minor work. **85,** 23.

1886. Repair of slopes. **86,** 24.

Part 21, FNF. Fort on Site of Fort Tompkins.

1858. Work begun. Description. **80,** 30.

1866. Fourteen platforms built; parapet and terreplein filled and sodded; barbette traverse magazine floors concreted; 9 casemate floor arches turned; work on lining casemates with brick; minor work. **66,** 10.

1867. Five casemates furred, 21 floored, and 9 fitted up for quarters; work on the road and repair of slopes; platforms for the guns on the 4 land fronts finished. **67,** 9.

1868. Work on latrines and outlet drains and roads, etc. **68,** 13.

1869. Drainage and repair of slopes. **69,** 13.

1870. Repair of slopes; building a picket fence. **70,** 19.

1871. $52,000 app. Constr. piers and arches of 17 bombproofs and scarp wall between sally ports; work on parade wall, sewers, connecting cisterns, and minor work. **71,** 14.

1872. $83,000 app. Completion of masonry of

2 gateways and 2 sally-port arches, walls and arches of passageways over sally ports; scarp wall n. and s. of sally port lowered 5′ and coping relaid; granite parade wall nearly finished; mastic placed on casemates and sally-port arches; minor work. 72, 11.

1873. $30,000 app. Swamp filled in and drained; glacis n. and nw. of fort graded; work on earth filling of cover face on chan. front; earthwork of casemates, and masonry and earthwork of traverses between guns completed; minor work. 73, 11.

1874. $30,000 app. Ten timber platforms laid and masonry breast-height wall built; comdletion of interior finish of casemate quarters in s. half of work; drainage; magazine doors finished; minor work. 74, 13.

1875. $20,000 app. Eight casemates prepared for quarters; walk, drainage, and slope work. 75, 14.

1876. Covered reservoir built; latrine work; hanging doors; minor work. 76, 14.

1877. Repair of earthwork; minor repairs; ests. in detail for completion. 77, 11.

1878. Repair of slopes and roads; drainage. 78, 13.

1881. Casemate floors raised and casemates prepared for storage of torpedo cases. 81, 29.

1882–83. General preservation and repair. 82, 25; 83, 22.

1884. Repairing walls, parade ground, roads, and slopes. 84, 27.

1885. Bonnet on se. angle of fort completed; 5 storm doors built; lamp closet fixtures supplied; repair of masonry of walls of ditch, roads, slopes; torpedoes painted. 85, 20.

1886. Pointing of masonry on scarp and counterscarp walls; painting torpedoes and exposed ironwork; repairing slopes; macadamized road leading from s. sally port of the fort to lighthouse begun. 86, 21.

Part 22, FNF. Staten Island—North Cliff Battery.

1862. Work begun. Importance. 80, 32.

1866. Seven platforms for 15-inch guns and breast-height wall built; n. traverse magazine built; drainage, embankment, and road making in progress. 66, 11.

1867. Completion of 5 platforms and breast-height wall; earth covering of n. traverse finished and the traverse completed; work on s. end of battery; excavation for large magazine in n. end of battery; some drainage. 67, 10.

1868. Principal magazine completed; work on filling above it; filling of parade in s. end; work on parados. 68, 13.

1869. Work on entrance walls; clearing the terreplein and roads of the slope washings; minor work. Est., proposed modifications of battery for heavy guns, $27,000. 69, 13.

1870–71. Slight repair of slopes. 70, 19; 71, 15.

1872. Masonry in principal and 2 traverse magazines completed; work on wall of covered passage in solid traverse; removal of old breast-height wall and platforms of s. end of battery. 72, 12.

1873. Earthwork and sodding over the 2 principal magazines completed; grading and sodding of large slope in rear completed; work on the additions to wing walls and earth cover of old traverse magazines and arch passageways. 73, 12.

1874. Foundations of 4 timber platforms and platforms laid; completion of additional masonry and earthwork to traverse magazines s. of the n. principal magazine. 74, 15.

1875. Two timber gun platforms laid; repair of earthwork. 75, 15.

1876. Slopes repaired. 76, 16.

1877. Est., modifications, $34,700. Minor work and repairs. 77, 12.

1878. Stone drain 60′ long built; work on slope. 78, 15.

1879. Work on slopes. 79, 18.

1881. Fifteen-inch gun from platform 1 dismounted and sent away. 81, 3.

1883. Repair of slopes, drains, etc. 83, 24.

1884. Repair of roads, drains, doors, and slopes. 84, 21.

1885. Replacing 5-inch pintles with new 6-inch pintles; work on doors, floors, and slopes. 85, 23.

1886. Repair of slopes 86, 23.

Part 23, FNF. Staten Island—New Casemated Battery.

1866. Work on test boring; 3,993 c. y. of ashlar cut for foundation courses and casemate piers and 4,919 c. f. of stone broken for concrete. 66, 11.

1867. Cutting stone in progress. Work on main battery proper not begun. 67, 10.

1868. Work on stone cutting and constr. of wharf. 68, 13.

1869. Work on wharf and care and preservation. 69, 13.

1870. Unexpended balance transferred to fort on site of Fort Tompkins. 70, 20.

Part 24, FNF. Staten Island—Glacis Mortar Battery (South of Fort on Site of Fort Tompkins).

1871. Earthwork and sodding completed; 2 service magazines nearly completed and granite coping laid on the entrance retaining walls; battery nearly completed. 71, 15.

1872. Battery completed except hanging doors and laying platforms. 72, 12.

1873. Battery finished except inner magazine doors and lamp closets. 73, 12.

1874. Armament mounted. Work on magazine doors and lamp closets. 74, 14.

1875. Work on lamp closets, etc. 75, 14.

1876–79. Slopes repaired. 76, 15; 77, 11; 78, 14; 79, 17.

1880. Importance of battery. 80, 34.

1885. Principal magazine floored slopes repaired, and minor work done. 85, 21.

1886. Repair of slopes and painting doors. 86, 22.

Part 25, FNF. Staten Island—South Mortar Battery (in Rear of Battery Hudson Extension).

1872. Work begun; importance of battery. 80, 32.

1873. Masonry and earthwork of s. branch and concrete foundations for 4 platforms completed. 73, 12.

1874. Work on magazine doors and picket fence. 74, 15.

1885. Painting doors and repairing slopes. 85, 22.

1886. Repairs of lopes. 86, 22.

Part 26, FNF. Staten Island—Glacis Gun Battery (on Site of Fort Tompkins).

1872. Work begun and battery finished except hanging doors and laying breast-height wall and timber platforms. 72, 12.

1873. Battery completed and made ready for armament. 73, 10.

1874. Magazine doors and lamp closet not yet completed. 74, 14.

1875. Minor work done on doors, slopes, etc. 75, 14.

1878–79. Minor repair of slopes. 78, 14; 79, 17.

1880. Importance of battery. 80, 31.

1885. N. service magazine floored, doors completed and hung; top revetment over breast-height wall resodded; and minor work. 85, 21.

1886. Repairing slopes and painting doors. 86, 22.

Part 27, FNF. Staten Island—Two-gun Battery (Near Southeast Angle of Channel Front of Fort on Site of Fort Tompkins).

1883. Description. Built toward the close of the Civil War. 83, 26.

1884–86. Repair of slopes. 84, 30; 85, 24; 86, 24.

Part 28, FNF. Southern Entrance—Five-gun Battery, Staten Island.

1891. 16,620 c. y. excavated and placed in embankment. **91,** 7.

1892. 8,485 c. y. concrete placed; minor work. **92,** 5.

1893. Concrete work and earth parapet nearly completed; terreplein roughly graded; ditch excavated and paved and rear earth slope graded. **93,** 7.

1894. Minor work done; awaiting the adoption of a gun carriage. **94,** 8.

1895. 968 c. y. of earth placed in parapet; masonry of fifth emplacement and of 4 platforms well advanced. **95,** 7, 504.

1896. Concrete and earthwork completed. Five guns and carriages received and mounted; latrines built, range finder and relocator house built; battery completed, except hoists, trolley, cranes, handrails, and lights. Battery transferred to commanding officer of the post. **96,** 477.

1897. Handrails placed; cranes, trolleys, and hoists erected; battery now complete. **97,** 613.

1898. Painting superior slope concrete. **98,** 629.

1899. Minor repairs. **99,** 773.

Part 29, FNF. Southern Entrance—Two 2-gun Batteries for 10-inch Guns, Staten Island.

1897. Work begun in July, 1896, on 2 batteries, each with 2 positions for 10-inch rifles. Platforms ready for carriages by December, 1896; parapet and magazines completed; 1 carriage being assembled. Artillery fire control—work begun on stations for range finder, observation, and searchlight. **97,** 613.

1898. Ammunition lifts, trolley, and cranes provided; magazine doors hung; superior slopes painted; 4 telephone booths built and electric-light plant installed. Batteries turned over to the commanding officer. **98,** 629.

1899. Minor repair of ammunition lifts and drainage system. **99,** 773.

Part 30, FNF. Southern Entrance—Battery of Three 10-inch and Four 12-inch Guns, Staten Island.

1897. Work begun by contract on emplacements for three 10-inch guns on disappearing carriages. Excavation and concrete work; 2 emplacements for 12-inch guns to be built by hired labor. **97,** 622, 623.

1898. Three 10-inch emplacements adopted in lieu of 1 of the originally proposed 2 iron casemates; battery completed under contract. Work begun on 12-inch emplacements. 9,732 c. y. concrete placed, magazines built, and 2 platforms ready for armament; work begun on the other 2 emplacements. **98,** 631, 632.

1899. Electric plant installed at 10-inch emplacement, completing same; 12-inch emplacement nearly completed; 2 guns and carriages received. Cost of work. **99,** 778, 779.

1900. Four 12-inch guns mounted; some waterproofing. **00,** 839.

Part 31, FNF. Southern Entrance—Two Emplacements for 8-inch B. L. Rifles on Modified 15-inch Gun Carriages, Staten Island.

1898. $6,000 allotted. No alteration required for platforms and magazines of old battery; 1 altered carriage nearly completed. **98,** 629.

1899. Work completed; guns received and mounted in August. **99,** 775.

Part 32, FNF. Southern Entrance—Twelve-inch Emplacements, Battery Richmond, Staten Island.

1898. The allotment from "National defense" for 2 emplacements, excavations nearly completed; platforms ready for armament; parapet and walls built to level of magazine ceilings. **98, 629.**

1899. Battery completed; machinery and lights installed; 1 base ring set. Range-finder house built. Cost of work. **99, 773.**

Part 33, FNF. Southern Entrance—Twelve-inch Emplacements, Battery Hudson, Staten Island.

1898. Excavation begun for 2 emplacements for 12-inch guns on disappearing carriages L. F. model 1896. **98, 629.**

1899. Magazines and platforms nearly completed; carriages received. Cost of work. Arrangement of plant shown on tracing. Range-finder house built. **99, 766, 774.**

1900. Emplacements completed, except small amount of sodding on slopes; armament being mounted. **00, 836.**

Part 34, FNF. Southern Entrance—Temporary Batteries, Staten Island.

1898. $5,000 allotted. Work begun in May for battery for three 8-inch converted rifles; platforms sand parapet, and magazines completed; battery ready for armament. **98, 629.**

Part 35, FNF. Southern Entrance—Rapid-fire Guns, Staten Island.

1898. $6,000 allotted for 2 emplacements for 4.7-inch guns to protect mine fields; work begun; platforms completed; guns mounted; emplacement completed except minor work. **99, 629.**

Part 36, FNF. Southern Entrance—Two Emplacements for 15-pounder R. F. Guns, Staten Island.

1899. Work begun in February and completed in June, 1899. **99, 775.**

Part 37, FNF. Southern Entrance—Two Emplacements for 6-inch R. F. Guns on Pedestal Mounts, Staten Island.

1899. Work begun in September, 1898; concrete work completed and guns mounted in December. **99, 775.**

Part 38, FNF. Southern Entrance—Two Emplacements for 6-inch Guns on Disappearing Carriages, Staten Island.

1899. Work begun in March. Emplacement 2 nearly completed; cost of work. **99, 774.**

1900. Emplacements nearly completed, except a small amount of parapet constr. **00, 836.**

Part 39, FNF. Southern Entrance—Defenses of Staten Island.

1901. $99,015 allotted. **01, 767.** Two 12-inch guns. Transferred to commanding officer Aug. 18, 1900. **01, 764.** Two 6-inch guns. Transferred Oct. 29, 1900. **01, 764.** Two 12-inch guns. Work begun, detailed statement of work accomplished given. **01, 765.** Work completed. **02, 688.** Electric-power station. $20,000 allotted. Excavation begun; awards made for furnishing boiler and other machinery. **01, 764.** Constr. completed. **02, 688.**

1902. $117,250 allotted. **02, 689.** New battery for two 12-inch guns on disappearing carriages, model 1901; excavation begun; 36,936 c. y. concrete work completed. **02, 688.** Peace Storage Magazine. Constr. begun; building nearly completed. **02, 688.** Miscellaneous work, such as installing electric plant, implement racks, telephone booths, constr. concrete pedestals, etc. done. **02, 688.**

Part 40, FNF. Fort Hancock, Sandy Hook, N. J.

1857. Work begun. Importance. **80, 33.**

1866. Work on scarp and casemate arches of the water fronts. **66, 11.**

1867. Work on scarp of ne. bastion, piers of nw. front, walls of service magazines; excavation for foundations of scarp and piers of the new terrace; work on jetties. **67, 11.**

1868. Work on the se., s., and sw. land front; minor work; repair of jetties 1, 2, and 4; jetty 6 commenced; minor work. **68, 14.**

1869. Work on land fronts continued. **69, 14.**

1870. Care and preservation. **70, 20.**

1871. $13,500 allotted. Work on additional jetties. **71, 15.**

1872. Two jetties built of sheet piling, each 150′ long. **72, 13.**

1873. Two jetties built, 1 of sheet piling and 1 of cedar piles and brush. **73, 12.**

1874. One jetty 109′ long built. **74, 15.**

1875. Care and preservation. **75, 16.**

1876–77. Repair of jetties and plant. **76, 16; 77, 12.**

1878. Sand box bulkhead 1,300′ long built. **78, 15.**

1883. $17,500 allotted. 766′ of concrete jetties built on the sites and remains of old jetties. **83, 26.**

1885. $5,000 allotted for stone revetment between jetties 8, 9, and 10; work completed; 57 shot beds made; repair of buildings. **85, 24.**

Part 41, FNF. Southern Entrance—Mortar Battery 1, with Ditch Defenses, Sandy Hook Defenses.

1890. $201,000 allotted. Work begun in November, 1890. **93, 600.**

1891. 30,000 c. y. excavated. **91, 7.**

1892. 13,025 c. y. concrete placed. **92, 6.**

1893. $53,000 allotted. 13,827 c. y. concrete masonry built and 118,478 c. y. sand filling placed; drainage system completed and 4 carriages received. **93, 600.**

1894. $20,000 allotted. Masonry and sand filling completed; mortar platforms built and carriages assembled, and mortars mounted and tested. **94, 449.**

1895. Final battery firing made; results shown. Proj. for electric-lighting system approv. and installed; description, with cost. **R.** by Col H. C. Abbot upon volley practice with mortars. **95, 8, 505 519.**

1896. Overhead traveler for handling ammunition adjusted; minor repairs to embankment and repainting doors. **96, 480.**

1897. Total cost of battery, $270,724.67. **97, 618.**

1898. Eight platforms dismantled and provided with index rings of the new pattern. **98, 631.**

1899. Eight more platforms dismantled and provided with new index rings. A pier built for emergency range finder. **99, 778.**

1900. Alterations completed. **00, 889.**

Part 42, FNF. Southern Entrance—Gun-lift Battery 1, Sandy Hook Defenses.

1891. $9,087.43 app. Excavation begun and nearly completed; 3,500 c. y. concrete placed; foundation for accumulator pit, 5′ below water, laid; and minor work. **91,** 7.

1892. $53,912.57 app. 29,875 c. y. concrete placed; mechanism placed. Est., battery for two 12-inch guns, $457,000. **92,** 6.

1893. $458,500 allotted (1891–93). Est. of cost. 8,292 c. y. masonry constr.; 5,185 c. y. sand placed in embankment, gun mounted and tested, and battery practically completed. **93,** 607.

1894. Ammunition service completed, bullet-proof entrance doors completed and hung, gun tested. **94,** 456.

1895. Second gun mounted, completing this battery; final drawing of completed battery made. Cost of constr. **95,** 8, 506.

1896. History; cost and ests. Rapidity of fire tested by BE.; results. Preservation and repair. **96,** 480.

1897. Description of battery; constr., expenses, and testing guns and mechanism. **97,** 619.

1898. Condenser for disposing of exhaust steam installed. Two range-finder piers for portable instruments built. **98,** 631.

1899. Three Gatling guns mounted for gorge defense; alterations made in pillars for emergency range finders. **99,** 778.

Part 43, FNF. Southern Entrance—Ten-inch Battery, Sandy Hook.

1897. $100,000 allotted for 1 battery of two 10-inch guns. Work begun, 1896. Battery completed, except ammunition lifts. No carriages received. **97,** 620.

1898. Two emplacements built on site originally proposed at a second gun-lift battery; ammunition lifts erected, electric lighting completed, and the battery turned over to the commanding officer. **98,** 631.

1899. Doors repaired; 2 concrete pillars built for emergency range finders. **99,** 778.

Part 44, FNF. Southern Entrance—Five-inch R. F. Battery, Sandy Hook Defenses.

1897. $4,000 allotted for 1 emplacement. **97,** 623.

1898. Work begun in September, 1897, and completed Apr. 21, 1898. **98,** 632.

1899. Alteration of platforms completed and gun mounted. **99,** 779.

1900. Alteration of platform made. **00,** 839.

Part 45, FNF. Southern Entrance—Pneumatic Gun Battery, Sandy Hook Defenses.

1898. Emplacements for two 15-inch and one 8-inch gun to be built by contract. Sand parapet built of sandbag retaining walls, nearly completed. **98,** 632.

1899. Sandbag retaining walls completed. Pillar erected for an emergency range finder. **99,** 779. Board walk built to connect with 10-inch battery, No. 2. **99,** 780.

1900. Concrete retaining walls and bombproof begun. **00,** 839.

Part 46, FNF. Southern Entrance—Six-inch R. F. Battery, Sandy Hook Defenses.

1898. $16,000 allotted. Plans approv. and railroad track to site of battery built. **98,** 632.

1899. One-third concrete work completed. Site interfered with ordnance proving ground; work suspended. **99,** 779.

Part 47, FNF. Southern Entrance—Fifteen-pounder R. F. Emplacements, Sandy Hook.

1899. Work begun in February for 2 emplacements and completed; awaiting arrival of carriages. **99,** 780.

1900. Carriages not yet received. **00,** 839.

Part 48, FNF. Southern Entrance—Defenses at Sandy Hook.

1901. $54,958.37 allotted. **01,** 769. Battery No. 2, 15-pounder R. F. guns. Work begun July, completed November. **01,** 768. Pneumatic dynamite-gun battery—temporary parapet and magazines removed and replaced by permanent ones. **01,** 768. Water supply system work completed. **01,** 768. Galleries, constr. of, for 10-inch emplacements, work completed. **01,** 768. Implement racks constr. and erection steel implement racks. Work completed except those for gun-lift battery. **01,** 768.

1902. $100,000 allotted. **02,** 692. Emplacements for 6-inch R. F. guns, pedestal mounts; work begun, plant erected, 1,864 c. y. concrete in place. **02,** 690. Emplacements for two 12-inch guns; operations in progress. **02,** 691. Electric light and power plant; work begun, brick building constr., switchboard set up and connected. **02,** 691.

Part 49, FNF. Southern Entrance—Seven-gun Battery, Long Island.

1893. $82,000 allotted. Work begun; 2,700 c. y. earth removed; constr. plant nearly completed. **93,** 7.

1894. 10,867 c. y. earth excavated and 10,362 c. y. concrete placed. **94,** 456.

1895. Pavement on superior slope nearly completed; drainage system put in; doors made and hung; and casemates prepared for R. F. guns. Table of cost of work. **95,** 7, 505.

1896. $72,600 allotted. Emplacements completed, awaiting arrival of carriage. Revised plans. **96,** 479.

1897. $45,000 allotted. Projs. Work on modification of 4 traverse magazines for 6-pounder R. F. guns; ammunition service and electric-light plant installed. **97,** 614.

1898. $100,000 allotted. Emplacements 4, 5, 6, and 7 completed; guns mounted and turned over to the commanding officer; work on emplacements 1, 2, and 3 begun and platforms for 2 and 3 completed. **98,** 627.

1899. Emplacements 1, 2, and 3 completed, and 3 carriages and 1 gun mounted. Cost of work. **99,** 768.

1900. Two remaining guns mounted and galleries connecting loading platforms built. **00,** 833.

Part 50, FNF. Southern Entrance—Mortar Battery, 12-inch Mortars, Long Island.

1898. Plans being prepared. **98,** 627.

1899. Work begun and excavation in progress. **99,** 771.

1900. 8,562 c. y. concrete placed; base rings for platforms set; work on parapet and slopes. **00,** 832.

Part 51, FNF. Southern Entrance—Rapid-fire Guns, Long Island.

1898. $6,000 allotted for two 4.7-inch R. F. guns; platforms 7 and 8 of 15-inch gun battery (water battery) altered for the R. F. guns; emplacement completed and guns mounted. **98,** 27.

1899. Drains cleaned. **99,** 77.

Part 52, FNF. Southern Entrance—Twelve-inch Battery No. 1, Long Island.

1898. $80,000 allotted from "National defense" for 2 barbette emplacements. Excavation in progress. Allotment from "Gun and mortar batteries" for 12-inch emplacements for disappearing carriages. **98,** 627.

1899. Emplacements 1 and 2 completed. Mounting carriages; cost of work. Allotment for emplacements 3 and 4 for two 12-inch B. L. rifles on disappearing carriages. Work begun in August, 1898. Excavation completed and concrete work in progress. Cost of work. **99,** 770.

1900. 7,489 c. y. masonry placed, completing concrete work. Battery nearly completed, guns mounted at 1 and 2, and carriages in 3 and 4. $5,000 allotted for raising two 12-inch delivery tables to adapt them to ammunition trucks issued by Ordnance Department. **00,** 833.

Part 53, FNF. Southern Entrance—Twelve-inch Battery in Stone Fort, Long Island.

1899. Plans approv. for two 12-inch B. L. rifles on disappearing carriages on the water face of the old stone fort. **99,** 770.

1900. 5,998 c. y. old masonry removed, 3,712 c. y. excavated, and 2,745 c. y. concrete placed. **008,** 33.

Part 54, FNF. Southern Entrance—Six-inch Battery, Long Island.

1899. Plans approv. for 2 emplacements for 6-inch B. L. rifles on disappearing carriages. **99,** 771.

1900. 3,604 c. y. old masonry removed, 2,121 c. y. excavated, and minor work. **00,** 833.

Part 55, FNF. Southern Entrance—Two 15-pounder R. F. Guns, Long Island.

1899. Two 8-inch converted rifles dismounted from platforms 1 and 2 of old water battery and work begun on new work; 290 c. y. earth excavated. **99,** 771.

1900. 659 c. y. concrete placed, 532 c. y. earth excavated, 400 c. y. placed in slopes; work nearly completed, ready for its armament. **00,** 832.

Part 56, FNF. Southern Entrance—Miscellaneous Defense Work.

1900. Allotment made and work begun. **00,** 840.

1901. $53 800 allotted. **01,** 763. Seven 10-inch guns; rear ditch widened; slopes sodded; retaining wall built; electric-light conduits laid. **01,** 762. Four 12-inch guns; emplacements 3 and 4 graded and sodded; doors hung; electric lights installed; guns mounted. **01,** 762. Mortar battery; 656 c. y. concrete placed; 5,529 c. y. earth embankment sodded; ditch macadamized, etc.; lighting system installed; battery completed; turned over Mar. 4, 1901. **01,** 762. Two 12-inch emplacements; 8,493 c. y. concrete placed; other work done; platforms completed; ready for armament. **01,** 762. Two 6-inch emplacements; 428 c. y. masonry removed; 4,317 c. y. concrete placed; parapets graded, doors hung, etc. **01,** 763. Installation electric-light plants. $30,000 allotted. Machinery ordered; constr. begun. **01,** 763. Four emplacements, 6-inch R. F guns on pedestal mounts; pre. work in progress. **01,** 763.

1902. Long Island defenses: $250 allotted. Two 12-inch and two 6-inch—Battery completed; misc. work of grading, sodding, etc., done. One 6-inch carriage and gun mounted; two 12-inch carriages and guns mounted **02,** 685. Four 6-inch R. F. guns; work begun; platforms ready for mounts. **02,** 686 Installation of electric lights; work completed. **02,** 686.

Part 57, FNF. Eastern Entrance—Fort Schuyler, East River (North Side of Eastern Entrance).

1833. Work begun. **80, 27.**

1866. Work on service magazines; glacis repaired, paving in sally port renewed, sea wall repaired, and buildings repaired and altered. **66, 8.**

1867. Two service magazines completed; work on 2 others; 15-inch gun platforms; stone parapet and breast-height walls; repair of buildings. **67, 7.**

1868. Two service magazines completed; laying two 15-inch gun platforms on the cover face; modifying casemates of lower tier of main work to adapt them for new iron carriages of 10-inch guns and repair of wharf and buildings. **68, 11.**

1869. Completing new magazines and gun platforms of the cover face, modifying casemates of second tier for 8-inch gun carriages (iron), placing gratings and shutters, and minor repairs Est. cost of modifications $308,000. **69, 11.**

1870. Care and preservation. **70, 17.**

1871. $57,500 app. Modification work begun, emplacements for 4 heavy guns completed on cover face; in the place-of-arms the parados, covering 2 magazines and a large bombproof, completed; new battery for 3 modern guns, at n. end of covered way, completed; minor repairs of sea wall, buildings, etc. **71, 13.**

1872. $85,000 app. Three brick arches, 1 heavy abutment pier, part of the new parade wall, and new coping to scarp wall built; bridge across both ditches completed; and minor work. **72, 10.**

1873. $65,000 app. Two large and 2 small brick arches built in n. front of main work; all arches covered with concrete and mastic; 1 traverse magazine built and partly covered with sand; new parade wall completed; removal of old stone parapet and parade wall in ne. front; 1 abutment and 2 intermediate piers built, and another abutment pier nearly completed; 2 stone arches turned. In 10-gun battery emplacements for 3 heavy guns provided, 4 traverse magazines built; 2 traverses-part of the parados and half of parapet built. **73, 9.**

1874. $25,000 app. Main work: North front—earthen parapet embanked and exterior slope graded; 2 center pintle platforms for 15-inch guns laid; traverse magazine No. 1 completed and partly sodded; traverse magazine No. 2 built, covered with mastic; minor work. Northeast front—parade wall finished and coping of scarp wall set; pier completed; casemate arches covered with mastic; minor work. Southeast front—abutment pier completed, 2 others built, and work on a third; old parade wall, stone parapet, and gun platforms removed, and minor work. Ten-gun battery—parapet, epaulement, and parados graded and sodded, and minor work. **74, 11.**

1875. $25,000 app. Main work: North face—work on earth and sand filling and completing platforms. Northeast face—work on traverse magazines 3 and 4. Southeast face—2 piers built, work on communicating arches, and all coping on this face backed with concrete. Ten-gun battery—bonnet with its retaining wall built; work on parapet. Torpedo casemate completed and 141 l. f. of torpedo gallery finished. **75, 11.**

1876. Main work: North face—work on earth parapet and minor work. Northeast face—magazine No. 4 completed; work on retaining wall and slopes. Southeast face—brick revetment built on coping of scarp wall; asphalt and lime mortar applied to large arch and coping of scarp wall; work on parapet. South face—old stone parapet and 1 platform removed, torpedo gallery completed. Ten-gun battery—work on rubblestone wall. **76, 12.**

1877–85. Care and preservation. **77, 9; 78, 11; 79, 14; 80, 27; 81, 25; 82, 20; 83, 16; 84, 22; 85, 16.**

Part 58, FNF. Eastern Entrance—Fort at Willets Point.

1863. Work begun. Importance. **80, 27.**

1866. Drain pipes laid under casemate floors of first tier: flagging laid for casemate floors and for terreplein outside of casemates; embrasure irons put in place; work on scarp walls, flagging, and traverse stones, on drain gallery and cut stone; basin finished. Minor work. **66 .8.**

1867. Work on scarp wall; completion of piers, casemate floors .second tier, nw. drain gallery; ne. drain gallery begun. **67, 8.**

1868. Completion of arch over service magazine in second tier, and of drain gallery in rear of ne. retaining wall .arch over salient casemate and 2 flank casemates in chan. bastion; excavation for storage magazine completed. **68, 11.**

1869. Work on storage magazine; fitting up service magazine for storage of powder; care and preservation. Est., earthen barbette battery for heavy guns, $180,000. **69, 11.**

1870. Work on storage magazine, breaking stone; drainage. **70, 17.**

1871. $45,000 app. Underground passage 270 long from the new bluff batteries to the water battery completed. Work on large storage magazine, 6 service magazines, and parapet, covering emplacement for 12 heavy guns. Battery ready for guns. **71, 13.**

1872. $76,500 app. Storage magazine completed; Little B. battery (2 guns), and w. battery (6 guns), with their 5 traverse magazines, essentially completed; excavation for mortar battery made; concrete stone prepared; extensive repairs of wharf. **72, 10.**

1873. $40,000 app. W. battery, with emplacements for 6 guns and 3 service magazines, completed, including most of its sea walls. Work on middle battery (10 guns), 4 guns could be mounted; e. battery (7 guns) begun; mortar battery (16 heavy mortars) ready for mortars. **73, 10.**

1874. W. battery—work on concrete foundation for one 15-inch front pintle gun platform and sea wall completed. Middle battery—3,000 c. y.

earth placed in parapet; sodding exterior slopes completed; platforms ready for four 15-inch guns; sea wall completed; 4 storage casemates completed; minor work. E. battery—6,000 c. y earth placed in parapet; 1 traverse magazine built and covered with earth, 2 others built and partly embanked; mortar battery completed, and platforms nearly ready for mounting four 13-inch mortars on hand 74, 12.

1875. $25,000 allotted. W. battery—one 15-inch platform completed; sodding exterior slope. Middle battery—work on traverse circles; platforms for two 15-inch guns completed and guns mounted; some sodding done; 3 storage casemates built; drainage and minor work. Mortar battery—4 wooden platforms for 13-inch mortars placed 75, 121.

1876. Torpedo casemates prepared. Mortar battery—minor work on slopes, 2 new storage casemates finished, some drainage. Sea wall built in front of little battery. **76,** 12.

1877. Sea wall extended; slopes repaired; storage casemates covered with earth; wharf strengthened, general repairs. **77,** 9.

1878. Earth placed on parapet and storage casemates; sea wall extended 543 l. f.; and minor repairs. **78,** 11.

1879. Repair of slopes, sea walls; earth covering of storage casemates; minor work. **79,** 15.

1880–86. Care and preservation. **80,** 26; **81,** 27; **82,** 22; **83,** 17; **84,** 23; **85,** 16; **86,** 17.

Part 59, FNF. Eastern Entrance—Gun Battery, South Side of Entrance.

1891. Excavation for 1 magazine for 8-inch guns and its approaches completed and concrete work begun. **91,** 7.

1892. One magazine and part of parapet connecting it with next emplacement completed and the second magazine begun. **92,** 6.

1893. 10,093 c. y. concrete placed, 10,628 c. y. earth excavated, and 4,384 c. y. placed in embankment; and minor work. **93,** 8.

1894. Work completed as far as possible; awaiting adoption of carriage. **94,** 9.

1895. Wharf repaired. **95,** 8.

1896. $20,540 allotted. One 10-inch emplacement completed, including mounting of carriage and gun. Work on the other emplacement. **96,** 476.

1897. $45,000 allotted. Another emplacement, No. 6, authorized April 22. Minor work and installation of trolleys—hoists and cranes for first 3 emplacements; 55 t. of granite and iron placed on gun platforms for settlement. Three 15-inch Rodman guns dismounted from site of emplacement 6; work begun. **97,** 612.

1898. Emplacements 1, 2, and 3 completed; emplacement 6, concrete work finished and earthwork nearly completed; ammunition lift, trolley, and cranes in place. $5,600 allotted for waterproofing. $100,000 allotted for two 12-inch gun emplacements 4 and 5; excavation begun. **98,** 626.

1899. Excavation for emplacements 4 and 5 completed; concrete work nearly finished. **99,** 765.

1900. Emplacements 4 and 5 nearly completed; guns mounted. Emplacement 6—rear roadway graded and side banks sodded. **00,** 830.

Part 60, FNF. Eastern Entrance—Battery for Sixteen 12-inch Mortars.

1891. 400 c. y. r. and 1,600 c. y. earth removed. **91,** 7.

1892. Buildings erected and wharf built; 7,379 c. y. earth excavated and 3,462 c. y. placed in embankment. **92,** 7.

1893. 1,939 c. y. r. removed; 2,166 c. y. earth excavated and placed in embankment; 1,860 c. y. stone crushed and 1,952 yards concrete laid. **93,** 8.

1894. Four platforms in progress, and anchoring bolts set; filling one-half completed; 4 carriages on hand. **94,** 9.

1895. Four carriages and mortars mounted in 1 pit; excavation of 3 other pits completed; 4 mortars and carriages on hand; floors placed in magazines, loading rooms, and one-half of galleries. **95,** 8.

1896. $32,106.79 allotted for battery, and $2,065.87 allotted for mounting guns and carriages; all platforms completed; 8 mortars and carriages received and mounted; work on retaining walls and embankment. **96,** 473.

1897. $9,700 allotted. Concrete slopes and pavements completed, embankment nearly finished, all carriages and mortars mounted and turned over to the troops. $5,200 allotted for electric-light plant building; completed. **97,** 610.

1898. $5,500 allotted for constr. of parapet and 1 emplacement for 8-inch B. L. rifle; earth parapet and magazines built. **98,** 624.

1899. $8,150 allotted. Platforms altered for new type of azimuth circle. Eight-inch B. L. rifle mounted on altered 15-inch S. B. carriage. Supplies purchased for electric plant. Imp. drainage completed. **99,** 762.

1900. New azimuth circles received and set. **00,** 828.

Part 61, FNF. Eastern Entrance—Mortar Battery for Eight 12-inch Modern Mortars, South Side of Entrance.

1897. $14,000 allotted. Plans for 8 platforms prepared. Cut stone ordered and excavation for drains begun. **97, 612.**

1898. $3,000 allotted. Platforms built and mortars and carriages mounted. **98, 626.**

1899. Shot trolley service installed. **99, 766.**

Part 62, FNF. Eastern Entrance—Two Emplacements for 10-inch Rifles on Disappearing Carriages, North Side of Entrance.

1897. Work begun in August, 1896. Wharf built and concrete plant set up. Excavation and embankment mainly done by contract. Platforms ready for the carriages. **97, 611.**

1898. 2,864 c. y. concrete placed. Guns and carriages mounted and battery completed, except minor work. Battery turned over to the commanding officer May 5, 1897. $75 allotted for introduction of water supply. **98, 625.**

1899. Water-supply system and electric lights installed. **99, 763.**

Part 63, FNF. Eastern Entrance—Emplacement 1, for 12-inch Rifle, Disappearing Carriage, North Side of Entrance.

1897. $50,000 allotted. Supplies purchased; rr. from wharf to site of battery nearly finished. **97, 611.**

1898. Concrete work of the parapet, platform, and magazines, and the earthwork of the parapet completed; cranes and trolley for handling ammunition set up. **98, 625.**

1899. Earthwork completed, machinery and electric lights installed, carriage and gun mounted, and emplacement completed. Electric plant installed, brick wall built at foot of slope, and drain put in. **99, 763.**

Part 64, FNF. Eastern Entrance—Platforms for Target Practice.

1896. Platforms for 2 practice guns—1 for 15-inch S. B. front pintle and 1 for 8-inch converted rifle completed; entire cost, $1,950. **96, 474.**

1900. Earthen barbette and temporary magazines built. **00, 828.**

Part 65, FNF. Eastern Entrance—Two Emplacements for 5-inch R. F. Guns, South Side of Entrance.

1898. $9,000 allotted. Work begun; platforms and magazine walls completed. **98, 626.**

1899. Change in carriages, necessitating change in platforms, completed; battery completed in May, 1899. **99, 766.**

1900. Slopes graded and sodded; electric wires placed; carriages received but not assembled. **00, 830.**

Part 66, FNF. Eastern Entrance—Two Emplacements for 15-pounder R. F. Guns, South Side of Eastern Entrance.

1899. Work begun in February, excavations completed, drains installed, and 258 c. y. concrete placed. **99, 756.**

1900. Emplacements completed and armed. Waterproofing. **00, 831.**

Part 67, FNF. Eastern Entrance—Two Emplacements for 15-pounder R. F. Guns, North Side of Eastern Entrance.

1899. Work begun in April; magazines completed. **99, 764.**

1900. Emplacements completed; guns not mounted. 184 c. y. concrete laid and 2,040 c. y. embankment built. **00, 829.**

Part 68, FNF. Eastern Entrance—Two Emplacements for 5-inch R. F. Guns, North Side of Eastern Entrance.

1899. Work begun in August, 1899, and completed, awaiting arrival of carriages. **99, 764.**

1900. Carriages received, base rings set, platforms paved, and roadway graded. Guns not received. **00, 829.**

Part 69, FNF. Eastern Entrance—Emplacement No. 2 for 12-inch Rifle, North Side of Eastern Entrance.

1899. Work begun in July, 1898. Platform completed. **99, 763.**

1900. Emplacement completed, except sodding. Carriage and gun mounted. **00, 829.**

Part 70, FNF. Eastern Entrance—Two Emplacements for 5-inch R. F. Guns.

1900. $20,000 allotted. Work begun in August, 1899; emplacements nearly completed; magazines covered with asphalt waterproof course; cost of work. **00, 828.**

1901. Emplacements completed; turned over to commanding officer. **01, 757.**

Part 71, FNF. Eastern Entrance—Two Emplacements for 6-inch R. F. Guns.

1901. $27,500 allotted. Excavation and clearing site begun. **01, 757.**

1902. Practically completed. **02, 679.**

Part 72, FNF. Southern Side of Eastern Entrance.

1901. $5,600 allotted. Two emplacements for 5-inch R. F. carriages received, set, and grouted; pavements finished; emplacements turned over Dec. 11, 1900. Disappearing gun battery: Two emplacements for 12-inch guns completed; hoists and magazines painted; electrical connections finished. Roads graded, etc.; iron galleries built; installation for electric-light plant completed and turned over Oct. 30, 1900. **01, 760.**

1902. $11,750 allotted for addition to building School of Submarine Defense; work in progress; 900 c. y. earth excavated; 100 l. f. 8-inch drain laid. **02, 682.**

Part 73, FNF. Northern Side of Eastern Entrance.

1901. $475 allotted. One emplacement for 12-inch gun (No. 2); grading done; drains made; turned over to Artillery Aug. 15, 1900. Two emplacements for 15-pounder R. F. guns; base rings set; guns mounted; turned over to commanding officer Dec. 22, 1900. Iron gallery to connect loading platforms of 10-inch battery; erected, painted, and completed; length, 55′. Electric tide indicator; constr. completed; turned over to commanding officer May 11, 1901. **01,** 758.

1902. $1,200 allotted. Repairs to 5-inch, 3-inch, and 12-inch emplacements No. 2; slope wall of 5-inch battery relaid; 5-inch guns received and mounted. **02,** 680.

Part 74, FNF. Preservation and Repair of Fortifications.

1897. $2,000 allotted for eastern entrance. Repairing sea wall and wharf. **97,** 612. Southern entrance to H.—roof of torpedo shed repaired and ironwork painted. Cost, $240.97. $790 allotted for gun-lift battery. **97,** 623.

1898. Eastern entrance—$2,561.58 allotted for electric supplies and correction of defective drainage in mortar battery; $350 allotted for repair of gallery and for platform for 8-inch converted rifle. **98,** 625. $1,550 allotted. 1,493 c. y. riprap placed along base of sea wall; wharf, buildings, and sewers repaired. **98,** 626. Southern entrance—sea wall in front of 10-inch battery repaired, and platforms 3, 4, 5, and 6 of water battery altered for 8-inch converted rifles; carriages and guns mounted, and slopes repaired and sodded. **98,** 628. Staten Isld.—$4,945 allotted. Repairs to old forts, sea walls, manholes in sewer; iron fence built; five 15-inch gun platforms altered to adapt them to carriages for 8-inch converted rifles. **98,** 630. Sandy Hook—ironwork and doors of mortar battery painted, and slopes repaired; electric wiring removed from wooden conduits and placed in iron pipes; minor work and repairs at gun-lift battery. **98,** 632.

1899. North side of eastern entrance—searchlight installed. South side of eastern entrance—wharf repaired; waterproofing and drainage of disappearing-gun battery. **99,** 766. Southern entrance—repair of electric plant; drainage surfaces of platforms of 10-inch guns and superior slope repaired. **99,** 77. Staten Isld.—old forts and new works repaired. **99,** 776. Sandy Hook—batteries and buildings repaired. **99,** 780.

1900. Eastern entrance—$284.80 allotted; storm doors built; minor work. **00,** 878. North side of eastern entrance—$200 allotted for repair of searchlight and constr. shelter. $700 allotted for waterproofing magazines and for minor repairs. **00,** 829. Long Isld.—$1,700 allotted. Minor repairs of slopes, cranes, hoists, pavements, drainage, etc. **00,** 834. Staten Isld.—$2,814 allotted. Repair of lifts, concrete platforms, drainage, mining material, etc. **00,** 838. Sandy Hook—$4,546.70 allotted. Rosendale cement pavement over magazine replaced with Portland. Sand slopes of mortar battery regraded to a slope of 1 upon 2; minor repair of other batteries. **00,** 840.

1901. Eastern entrance—$400 allotted. Retaining wall, new manhole built, and drains cleaned; minor repairs. **01,** 757. North side of eastern entrance—$1,700 allotted for rewiring and waterproofing 10-inch and 12-inch batteries. **01,** 758. South side of eastern entrance—painting done; repairs made; $600 allotted. **01,** 760. Long Isld.—$2,500 allotted. Various repairs made. **01,** 763. Staten Isld.—$3,900 allotted. Material cared for and cleaned; mining casemates, building, etc., transferred to Artillery Mar. 6, 1901. **01,** 764. Sandy Hook—$11,630 allotted. At gun-lift battery, flagstone replaced with waterproof course; new electric-light equipment installed at mortar battery; repairs to drains. **01,** 768.

1902. Eastern entrance—ground cleaned up, etc. **02,** 679. North side eastern entrance—repairs to ammunition hoist; new drainage outlet made; new drains laid, etc. **02,** 681. South side eastern entrance—$1,558 allotted. Slopes cleaned; repairs to roadway, engineer wharf; doors painted, and misc. work. **02,** 682. Long Isld.—doors hung; racks placed; slopes repaired. **02,** 686. Staten Isld.—$1,044 allotted. Removing arch; repairs to steps, windows; constr. new br.; painting roofs, etc.; paving. **02,** 689. Sandy Hook—areas rear of batteries covered with cinders; instrument room and ventilating doors built; waterproofing done; railroad tracks moved; and pneumatic gun battery dismantled. **02,** 691. Fort Columbus—$5,000 allotted for necessary repairs. **02,** 683.

Part 75, FNF. Range and Position Finders.

Eastern entrance. **96,** 477; **97,** 613. Artillery fire control. **97,** 613; **98,** 629; **99,** 776. Four range-finder houses built and turned over to the Board on Regulation of Seacoast Artillery Fire. **98,** 630, 631; **99,** 776. Southern entrance to H. **99,** 771, 779. Sandy Hook. **99,** 780; **00,** 840. North side of eastern entrance; 2 stations built. **00,** 829. Long Isld.—two stations built and turned over to commanding officer. **00,** 833. Long Isld.—one fire commander and two battery commander stations au.; materials purchased; work begun. **01,** 763. Completed and turned over; temporary concrete platforms constr. **02,** 686. Sandy Hook—two range-finder towers built by contract. **01,** 768. Southern side of eastern entrance—$14,000 allotted. Constr. 4 range-finder shelters; work begun; change of location considered; work suspended. **02,** 682.

Part 76, FNF. Searchlights.

1901. $68,700 allotted ($26,900 transferred to electric plant) for purchasing searchlights at southern entrance. **01,** 769; **02,** 693. Searchlights reassembled for shipment to service schools. **01,** 770. Long Isld. defenses—$11,500 allotted. **01,** 764. Staten Isld.—$21,000 allotted. **01,** 767.

Act Mar. 1, 1901, app. $150,000 for searchlights. N. Y. H. **03,** 14.

Part 77, FNF. Sea Walls and Embankments.

Bedloes Isld. (eastern entrance)—est. cost of 580 l. f. of new sea wall, $25,000. **94,** 14; **96,** 478.

1901. Sea wall at Bedloes Isld.—$20 000 allotted. Building masonry wall to be 714′ l., 8.4′ above m. l. w. proposed; no work done. **01,** 762.

1902. Wall completed; 723′ l., 8.4′ above m. l. w. **02,** 684.

Davids Isld. (eastern entrance)—slight repairs. **94,** 14. Repairs made to riprap and coping, and 750 c. y. riprap placed back of wall. **96,** 477. $47,000 allotted for sea wall and earth embankment. Plans. Work begun in May; 4,046 tons of riprap placed and 625 c. y. of embankment placed, **89,** 458. 5,022 t. o riprap and all capping placed, completing the wall; 27,650 c. y. of material placed in embankment, nearly completing contract. **90,** 382. 3,555 c. y. of earth placed in embankment, completing same. Survey made 1891. **91,** 521. Report of a survey made of Davids Isld., by Col. Houston; with design for constr. of a sea wall. **92,** 460.

1901. Eastern entrance—$10,000 allotted for constr. sea wall; materials purchased; plant prepared. **01,** 757.

1902. Work continued; 375 l. f. built. **02,** 679.

Willets Point, Ft. Totten (eastern entrance)—$2,500 app. 1888, for repairs to wharf and sea wall at Willets Point. **11,** 16.

Fort Schuyler (eastern entrance)—Repairs. **86,** 17. $4,225 allotted for repairs; completed. **96,** 477; **97,** 611; **98,** 625. $2,400 allotted for protection of shore north of barracks. **99,** 764. $10,000 allotted for sea wall on the north shore of reservation. **00,** 830.

1901. North side eastern entrance—$15,000 for constr. 800 l. f. sea wall; in addition to 1,343′ of wall on north shore of reservation. 50 l. f. built. **01,** 759. $4,600 allotted. Work in progress. **02,** 681.

Governors Isld. (southern entrance)—107 c. y. of cut stone, 172 c. y. of concrete foundations, and 162 c. y. of concrete backing laid in sea wall; 47′ of coping placed. **66,** 9. $54,000 app. Proj. of 1865 provided for inclosing the entire isld. with a sea wall 1,750′ l., 8′ h. Work begun in May, 1883, to complete sea wall; 300 l. f. built; work done by contract. **83,** 19, 385. $500 allotted. 206′ of wall built. **84,** 25; **86,** 18. $50,000 allotted, 1888. Plans. Foundation completed for 261′ from the Castle Williams wall; 180′ of cut stone wall built. **89,** 460. 319 c. y. of concrete foundation, and 1,421 c. y. of masonry wall laid; 21,447 c. y. of earth placed in embankment. **90,** 384. $50,000 app. History of work. 144 c. y. concrete foundation placed and 153 l. f. masonry wall built. **91,** 525. $6,597.86 transferred from Davids Isld. Total of work done to date—659 c. y. of concrete foundation and 1,499 l. f. of masonry wall laid; 1,856 c. y. of embankment placed behind n. wall, and 39,544 c. y. behind w. wall; description of sea walls around entire isld. **92,** 461. $4,000 transferred from Davids Isld. 396 l. f. wall built, 685 c. y. riprap placed, and minor work. **93,** 631. Riprapping completed, pointing of masonry finished, embankment back of w. sea wall protected with broken stone for a width of 12′; proj. completed. **94,** 14.

1901. Sea wall, Governors Isld.—$250 allotted. Washout repaired. **01,** 761.

1902. $1,000 allotted for misc. repairs **02,** 684.

Sandy Hook (southern entrance)—$7,500 allotted. Sea wall to protect pneumatic guns completed in 1894. 4,546 t. of stone placed; cost, $5,298.03. **96,** 483. $75,000 app. Violent storm, 1897, broke through sand spit of Hook and closed up chan. of Shrewsbury R., threatening the only land communication with the fortifications at Sandy Hook. Riprap wall to close the breach built under contract; 57,165 t. of riprap placed. **98,** 633.

1901. Sandy Hook—$2,000 allotted for work on sea wall; operations in progress. **01,** 768.

1902. Sea wall completed; jetty built near dynamite-gun battery. **02,** 692. $75.000 app. 1902, for riprap stone wall eastern beach. **11,** 7. $40,000 app. 1905, for sea wall, north beach. **11,** 17.

Part 78, FNF. Sites.

Coney Isld.—After ex., new site selected. **92,** 9. Plumb Isld.—50 acres acquired by condemnation proceedings; $99,547.76 paid. **92,** 9. Fort Hamilton—56.54 acres acquired by condemnation proceedings; $302,768.13 entire cost. **92,** 9. Act of State legislature; land acquired adjacent to reservation ceded to U. S. **93,** 10. Bayside (near Keansburg), N. J.—25.3 acres purchased for $200 an acre. **92,** 9. Staten Isld.—Tract No. 1 of the King property purchased for $60,000. **98,** 630. Site purchased for $51,000 in 1898. **99,** 776. $95,000 allotted for purchase of 3 tracts of land; proceedings instituted. **00,** 838. Fort Wadsworth, west of—14 acres purchased for $110,000. Condemnation proceedings instituted for acquisition of 115 acres. **92,** 9. 82 acres acquired by condemnation proceedings; price, $599,497.30. **93,** 10. 6½ acres purchased for $53,680. **95,** 504. Sandy Hook, N. J.—28 acres acquired at cost of $25,000. **93,** 11. Staten Isld. defenses. Condemnation proceedings instituted for acquisition of 2 properties. **01,** 766.

1902. Staten Isld.—$18,100 allotted for purchasing land. **02,** 689.

Part 79, FNF. Submarine Mines.

1891. $9,000 allotted. Five mining casemates completed. **91,** 7.

1892. Two special storage sheds completed. **92,** 9.

1893. Description of torpedo shed. **93,** 617; **94,** 456.

1894. Torpedo shed completed; cost, $3,323.51. **94,** 447.

1898. Southern entrance to H.; $30,000 allotted. Staten Isld.—mining casemate, torpedo storehouse, and tank built in 1897; oil engine installed in casemate; water supply introduced and a passage opened from the casemates to the chan.; movable hoist and traveling crane set up; minor work. $23,250 allotted for planting mines. **98,** 628. Sandy Hook—2 storage tanks constr. by remodeling 2 cisterns in the old stone fort; mines planted, 2 searchlights installed, one 5-inch siege rifle, one 7-inch siege howitzer, and one 4.7-inch R. F. gun mounted on temporary emplacements. **98,** 632. Eastern entrance to H.—description of mines placed. **98,** 635.

1899. South side of eastern entrance—mining casemate built. **99,** 766. Eastern entrance—all torpedo defense removed from mine fields; mines exploded; second mining casemate built and turned over to the commanding officer. **99,** 767. Southern entrance—supplies for electric lighting and searchlights purchased. **99,** 771. Staten Isld.—mines and cables taken up, cleaned, and stored; 2 additional cable tanks built. **99,** 773.

1900. Defenses of the Narrows—mines and cables taken up, cleaned, and stored; 2 mines lost; repair of electric plant. Sandy Hook—2 cable tanks built; cranes installed and cable stored; new water tank built; casemates wood-lined and waterproofed; mines taken up, cleaned, and stored. North side of eastern entrance—searchlights to be reassembled and sent to one of the service schools. **99,** 829. Staten Isld.—electric conduit system laid to connect battery commanders' and fire commanders' stations; reassembling portable searchlight outfits. **00,** 836. Sandy Hook—$3,000 allotted for reassembling portable searchlights; stored cable overhauled and examined; repairs to instruments made. **00,** 840. Eastern entrance—mining material moved to Willets Point, N. Y.; plans placed in charge of c. o. post. **01,** 761. Sandy Hook—mining material cared for. **01,** 768. $152 allotted. **02,** 693. Southern side, eastern entrance—$6,500 allotted. Extension of shed to laboratory; engine repaired; magazines connected; addition to mining casemate. **02,** 682.

Part 80, FNF. Supplies for Seacoast Defenses.

1901. $1,000 allotted. Purchases made and articles issued. **01,** 770.

1902. Staten Isld.—$3,200 allotted. **02,** 690. $1,000 allotted. **02,** 694.

Part 81, FNF. U. S. Mastic Works on Governors Island, New York Harbor.

ENGINEERS.

Chief of Engineers. **R.,** **80,** 62; **81,** 63; **82,** 62.

In charge. Col. J. Newton. 1880–82.

OPERATIONS.

1880. 236,170 pounds mastic and 65,760 pounds bitumen procured some years since for covering the arches of casemates of fortifications. This material was transferred January 24 to the post quartermaster on Governors Isld. for storage, subject to requisition. **80,** 62.

1881. 1,980 pounds of mastic and 4,275 pounds of bitumen sold to officers for public works. **81,** 63.

1882. 9,447 pounds of mastic and 1.669 pounds of bitumen sold to officers for public works. **82,** 62.

FNH. DELAWARE RIVER FORTIFICATIONS.

(NOTE.—Reports on these works from 1903 to 1912 are of a general character only. See the first 15 pages of each annual report from 1903 to 1912.)

Part.	Title.	Period.
1	Contracts	1895–1902
2	Engineering features	1896–1905
3	Engineers—Chief of Engineers	1866–1902
4	BE	1882–1894
5	In charge	1865–1902
6	Assistants	1892–1900
7	Forts, etc.—Operations, allotments, etc	....
8	Philadelphia, Pa	....
9	Fort Mifflin, Pa	1866–1899
10	Mortar battery	1871–1886
11	Red Bank, N. J	1873–1897
12	Fort Delaware, Del	1866–1899
13	Fort Mott, N. J. (Finns Point)	1866–1886
14	Finns Point, mortar battery, N. J	1872–1882
15	Fort Du Pont, Del., earthen barbette battery	1866–1886
16	Mortar battery, near Delaware City, Del	1872–1885
17	Battery, Delaware shore	1879
18	Delaware Breakwater, fort near	1866–1869
19	Three-gun lift battery (three 12-inch guns, disappearing carriages)	1895–1901
20	Battery, three 10-inch and three 12-inch disappearing guns	1896–1901
21	Battery, two 5-inch R. F. guns, balanced-pillar mounts	1897–1901
22	Mortar battery	1897–1901
23	Two emplacements, 8-inch disappearing guns	1898–1900
24	Two emplacements, 12-inch B. L. rifles, barbette carriages	1898–1900
25	Emplacements, two 4.72-inch R. F. guns	1898–1899
26	Emplacements, 15-pounder R. F. guns (12-inch disappearing-gun battery)	1899–1901
27	Emplacements, two 5-inch R. F. guns, wire wound (10-inch and 12-inch battery)	1900–1901
28	Emplacements, two 5-inch R. F. guns, wire wound (between river and mortar battery)	1900–1901
29	Emplacements for two 15-pounder R. F. guns	1901–1902
30	Magazine for 3-inch R. F. gun	1901
31	Converting old magazines into casemates	1901–1902
32	Preservation and repairs	1898–1902
33	Range and position finders	1900–1902
34	Sea walls and embankments	1866–1899
35	Sites	1871–1896
36	Submarine mines	1875–1902
37	Supplies	1901–1902

Part 1, FNH. Contracts.

1895. Engines, boilers, generators, switchboard and testing apparatus of electric plant, $2,975; electric locomotive, $1,200; 2 electric derrick motors, $1,800; 2 pile drivers, $812; 2 concrete mixers, $482; 1 naphtha launch, $1,950. **95,** 508.

1896. 15,000 barrels Rosendale cement, 85¢; 10,000 c. y. small broken st., $1.02; 3,000 t. large broken st., 85¢; 4,000 c. y. sand, 45¢. **96,** 487.

1897. 25,000 c. y. small broken st., $1.32; 9,000 t. large broken st., 90¢; 18,000 c. y. sand, 29½¢; electric plant, $5,089; 6 ammunition hoists, $4,335. **97,** 636.

1898. 150,000 c. y. embankment sand, 23½¢; asphalt waterproofing, $1.26 per sq. y., in place; 15,000 c. y. small broken st., $1.23; 25,000 barrels Rosendale cement, 71¢; 7,500 c. y. building sand, 28¢; 2,000 t. large broken st., 85¢; 1,300 barrels Portland cement, $2.15; 6,000 barrels Rosendale cement, 80¢; 1,250 barrels Portland cement, $2.20. **98,** 645, 650, 653.

1899. 36,000 barrels Rosendale cement, 68¢; 24,000 c. y. small broken st., 96¢; 5,000 t. large broken st., 73¢; 9,000 c. y. washed sand, 28¢; 18,000 c. y. unwashed sand, 24¢; 163,650 pounds steel beams, 1.4375¢; 4,000 barrels Portland cement, $2.10; 127 barrels Portland cement, $2.50. **99,** 788, 789, 800.

1900. 9,000 c. y. unwashed sand, 22¢; 1,700 c. y. small broken st., $1.37; 1,000 barrels Portland cement, $2.21; 217 sq. y. asphalt pavement, 1 inch thick, $1.44; 1,006 sq. y. asphalt pavement, 1½ inches thick, $1.62; 3 chain ammunition hoists for 12-inch guns, $1,080; 2 double chain ammunition hoists for 15-pounder guns, $984; 1,600 c. y. small broken st., $1.56. **00,** 847, 852, 857, 864.

1902. Materials for constr. of a steel tower, $5,250. **02,** 698.

Part 2, FNH. Engineering Features.

Air spaces in concrete side walls. **97,** 631; **99,** 786; **00,** 849.

Ammunition hoists, electric. **97,** 631; **99,** 784 (drawing), 795 (drawing); **00,** 853, 857; **05,** 3008 (pl.).

Asphalt pavement. **00,** 849, 852.

Cables; clamps. **05,** 3008 (pl.).

Ceiling, constr. of. **99,** 786, 798; **00,** 843, 859.

Concrete, cost of. **97,** 634; **98,** 640, 642, 647, 652; **99,** 792, 796, 799; **00,** 854.

Concrete of superior slope. **97,** 630; **98,** 651; **99,** 798; **00,** 848, 854.

Concrete-mixing plant. **97,** 629; **99,** 792 (drawing).

Materials, cost of, and of handling. **97,** 633; **98,** 640, 646, 652; **99,** 792, 799; **00,** 853.

Cranes, ammunition. **00,** 850 (drawing).

Dampness in magazines corrected. **00,** 843, 859.

Doors, steel and brass. **99,** 791 (drawing).

Earth and sand filling, cost of. **97,** 634; **98,** 640, 642, 647; **99,** 792, 796, 799; **00,** 854.

Electric plant, light and power. **99,** 795 (drawing); **00,** 850.

Electric plant used in constr. work, unloading and transporting materials. **96,** 485.

Employees, distribution in gangs on work. **97** 632.

Excavation, cost of. **97,** 634; **98,** 640, 647; **99,** 796, 799; **00,** 855.

Expanded metal. **99,** 787; **00,** 843, 859.

Latrines. **99,** 798.

Magazines: Peace storage of smokeless powder. **05,** 3007.

Mounting mortars, cost of. **98,** 645.

Mounting 12-inch barbette guns and carriages. **00,** 861.

Mounting 12-inch disappearing guns and carriages. **98,** 638.

Piles in place, cost of. **00,** 854.

Plant, constr. **99,** 792 (drawing).

Switchboard. **00,** 850 (drawing).

Temperatures, outside and inside emplacement. **05,** 3007.

Tile for ceiling and walls. **99,** 786; **00,** 849.

Ventilating, system of. **99,** 787; **00,** 860.

Waterproofing, methods of. **98,** 645, 652; **99,** 783, 798; **00,** 849; **05,** 3007.

Wiring, electric. **98,** 644; **00,** 850.

Work, amount of accomplished per gang (unloading, excavating, mixing concrete, etc.). **97;** 633

Part 3, FNH. Engineers.

Chief of Engineers. **R.,** **66,** 12; **67,** 12; **68,** 14; **69,** 14; **70,** 20; **71,** 16; **72,** 13; **73,** 13; **74,** 15; **75,** 16; **76,** 16; **77,** 13; **78,** 15; **79,** 19; **80,** 33; **81,** 33; **82,** 30; **83,** 26; **84,** 31; **85,** 25; **86,** 25; **93,** 8; **94,** 9; **95,** 8; **96,** 15; **97,** 14; **98,** 20; **99,** 22; **00,** 6, 20, 35; **01,** 21; **02,** 21.

Part 4, FNH. Boards of Engineers.

1882. Constituted to consider and report upon the condition of fortifications and what number, if any, could be dispensed with. **R.,** **82,** 420.

1887. The BE. est. that one 16-mortar battery and two 12-inch disappearing guns could be built on Pea Patch (isld.) for $210,000; also est. for 2 mining casemates. **87,** 11.

1894. Report of board constituted to consider and report upon price to be fixed for land in vicinity of Fort Mifflin au. to be sold. **94,** 461.

Part 5, FNH. Engineers in Charge.

Col. H. Bache, 1865.
Lt. Col. C. S. Stewart, 1865–70.
Lt. Col. J. D. Kurtz, 1870–77.
Capt. Wm. Ludlow, 1877.
Col. J. N. Macomb, 1877–82.
Maj. Wm. Ludlow, 1882.
Lt. Col. G. Weitzel, 1882–84.
Lt. T. L. Casey, 1884.
Maj. W. H. Heur, 1884–85.
Lt. Col. H. M. Robert, 1885–90.
Lt. Col. C. W. Raymond, 1890–1902.
Lt. S. Cosby, 1900.
Col. J. A. Smith, 1902.

Part 6, FNH. Assistants.

Lt. A. M. D'Armit, 1892.
Capt. S. Cosby, 1894–1902.
Lt. S. Cheney, 1897–98.
Lt. F. W. Altstaetter, 1898.
Lt. J. B. Cavanaugh, 1900.

Part 7, FNH—

FORTS AND BATTERIES.

Part 8, FNH. Philadelphia, Pa.

General description of the defenses and the necessity for them. 73, 13.

Part 9, FNH. Fort Mifflin, Pa. (Old Stone Fort).

1866. Platforms altered, magazine built, and sundry repairs made. **66,** 12.

1867. Magazine completed, new traverse stones put in platforms, and ditch cleaned. **67,** 11.

1868. Changes made in and about magazine; ditches cleaned; wharf, sluice, etc., repaired; operations contemplated for future. **68,** 14.

1869. Necessary small repairs made; alterations proposed, at an est. cost of $107,000, to furnish additional emplacement and to construct a new earthen battery for heavy guns. **69,** 14.

1870. App. made to carry out proposed plans and work to be carried on rapidly; no expend. during year, except for care of property. **70,** 20.

1871. Two small service magazines completed; various repairs made to dikes, roads, brs., ditches, 15-inch platforms, buildings, etc.; new sluice constructed; future work specified **71,** 16.

1872. 1,700′ of dike reconstructed; minor work and repairs executed. **72,** 13.

1873. St. revet. placed along dike of back chan.; constr. material received; minor repairs and work executed; app. of $55,000 asked for; work proposed for ensuing 2 fiscal years. Fort will be prepared during the year to mount 17 large guns **73,** 13.

1874. S. battery of demilune completed; dike along s. boundary finished; exterior battery partly embanked and graded; various repairs executed. **74,** 15.

1875. Exterior battery for 9 guns embanked and slope graded; 6 st. platforms made ready. **75,** 16.

1876. Nine wooden platforms laid; masonry of part of breast-height walls and of 2 magazines completed; 700 c. y. of sand embanked in battery; dike, slopes, and moat repaired. **76,** 16.

1877. A few minor repairs executed; no app. made. **77,** 13; **78,** 15.

1879. Breaches in dike and other damages caused by severe storm repaired; plans for adapting works for modern heavy ordnance were prepared by BE., but only partly completed. **79,** 19.

Report made Nov. 13, 1878, by Col. J. N. Macomb, on the storm of Oct. 23, 1878, which was. in severity, almost without parallel. The tide attained the unprecedented height of 11 f. 3 in. above l. w., accompanied with wind blowing from ene., veering to ese. and to s., with a velocity of 49 to 72 m. per hour. Dikes breached and badly washed, 4 brs. lifted from position and floated away, many buildings were destroyed, floor of main magazine, torpedo casemate, and other magazines submerged. The greatest d. of water on the parade ground of the fort was 4 f. 9 in.; $6,600 was est. as the total cost for protection from overflow of the sites of fortifications. **79,** 237.

1880–81. Short history of fort given; present condition described; no work done except for protection and repair. **80,** 33; **81,** 33.

1882. Extensive repairs made to dikes; sluices, parapet, brs., and buildings repaired; fog bell erected on wharf. **82,** 30.

1883–86. General repairs made. **83,** 27; **84,** 31; **85,** 25; **86,** 25.

1894. Sale of land in vicinity au. and board appointed to report upon price and conditions of sale. **94,** 9, 461.

1896. Damage done to wharf and banks by storms in 1893, 1894, and 1896; portion of reservation assigned to Navy Department for magazine purposes, another portion leased to Mrs. M. M. Black; $3,000 to be expended from R. and H. app. in rebuilding and enlarging dike. **96,** 487.

1897. Work on dike placed under contract and completed. **97,** 639.

1898. 280′ of dike repaired and sluice renewed. **98,** 657.

1899. Washout in 1,080′ of bank filled in; 370′ raised and revetted; total cost, $1,196. **99,** 794.

Part 10, FNH. Fort Mifflin, Pa. (Mortar Battery).

1871. $21,000 apportioned to the H. of Philadelphia for emplacement of 6 mortars. **71,** 26. Proposed to build battery for 6 mortars s. of fort. **71,** 16.

1872. Masonry for 2 service magazines carried forward. **72,** 13.

1873. Magazines loaded to test soil; sand placed in parapet. **73,** 13.

1874. Minor work and repairs executed. **74,** 16.

1875–79. No work done for lack of funds. **75,** 16; **76,** 16; **77,** 13; **78,** 16; **79,** 19.

1880–86. Site of battery and work done described; no work since 1874. **80,** 34; **81,** 34; **82,** 31; **83,** 27; **84,** 32; **85,** 26; **86,** 25.

Part 11, FNH. Red Bank, N. J. (Site for the Defenses at).

1873. Site surveyed and plot prepared. Act giving consent of State of New Jersey to purchase of land approved. Position of great importance. **73,** 13, 14.

1874–78. Repairs made to dikes, buildings, sluices, and fences. **74,** 16; **75,** 16; **76,** 17; **77,** 13; **78,** 16.

1879. No works constructed on site for lack of funds; dikes injured by storms and partly repaired. **79,** 19.

1880–81. Site described and history mentioned; dike repaired. **80,** 35; **81,** 34.

1882–83. Site described. **82,** 31; **83,** 27.

1884. Site and conditions described. **84,** 32.

1885. Dikes repaired and shore protected. **85,** 26; **86,** 26.

1896. Meadow banks breached by storm in 1893, no injury to Government property; reservation leased to Mr. C. Whitall; $2,500 from R. and H. app. to be spent in rebuilding dike. **96,** 488.

1897. Work on dike placed under contract and completed. **97,** 639.

Part 12, FNH. Fort Delaware, Del. (Stone Fort).

1866. Various minor works of constr. carried on, dock wall built for 195′, glacis completed. **66,** 12.

1867. Dock wall extended 158′; repairs made to parade wall, glacis, embankment of the isld., quarters, etc. **67,** 11.

1868. Dock walls, and ditches extended, sluiceways finished, embankment and quarters repaired. **68,** 14, 15.

1869. Minor repairs made to platforms, wharves, etc.; proposed to modify bastions of work to furnish emplacements for heavy guns. **69,** 14.

1870. Slight repairs made; app. made by Congress to carry out approved proj.; work required permanent wharf; dock walls to be completed, and large repairs to levees. **70,** 20.

1871. Six magazines for large guns constructed of concrete; traverses begun; levee rebuilt for 2,450′; st. revet. relaid and main ditch repaired. Future works specified. **71,** 16.

1872. Nine magazines and traverses finished on terreplein; minor work and repairs executed; observations on force and direction of current completed. **72,** 13.

1873. Two barbette platforms for 15-inch guns, with breast-height walls, completed; wharf head temporarily rebuilt; proposed work mentioned. **73,** 14.

1874. Three remaining platforms for 15-inch guns put down; extensive work done on magazines; iron balconies, etc., of barbette; iron shield used for experimental firing removed; ditches dike, and wharves repaired. **74,** 16.

1875. Breach made by experimental firing repaired; iron balconies built in rear of traverses; st. superstr. commenced for eastern wharf. **75,** 16.

1876. Small amount available applied to repairs most necessary on wharves, flagging, buildings, etc. **76,** 17.

1877. Damages to wharf and dike caused by severe storm repaired; temporary repairs made to upper wharf. **77,** 13.

1878. Operations confined to care and preservation of property and slight repairs. **78,** 16.

1879. Isld. submerged and great damage done by storm; dikes repaired; ditches cleaned; brs., sluice gate, etc., rebuilt. **79,** 19.

Report made Nov. 6, 1878, by Col. J. N. Macomb, on the storm of Oct. 23 1878. The wind blew from the s. and e. with a velocity at times of 70 m. per hour, and the water rose to a height of 11 f. 7 in. above l. w., causing the highest tide ever known. Of the 31 buildings exterior to the fort 12 were destroyed and the remainder much damaged. All brs. except 1 were destroyed. $11,850 was est. as the total cost for protection of this site from overflow. Record of occasional full tides since 1871. **79,** 238, 243.

1880–82. Site of work and condition described, also repairs needed; modifications urged; minor repairs made. **80,** 35; **81,** 35; **82,** 32.

1883. Site and importance described; nothing done. **83,** 28.

1884. General repairs made. **84,** 33.

1885. Repairs made to brs., slopes, fences, buildings, and masonry of platforms; 25 barbette platforms modified to adapt them to modern iron carriages. **85,** 26.

1886. Two platforms modified and 7 leveled; small repairs to grounds and ditches. **86,** 26.

1898. Special allotment of $6,000 made to clean moat and ditches of isld., work deferred. **98,** 643.

1899. Au. obtained to do work by hired labor. 14,110 c. y. removed from ditches and 6,120 c. y. from moat; methods described. **99,** 802.

Part 13, FNH. Fort Mott, N. J. (Finns Point)—Barbette Earthen (10-gun) Battery, Opposite Fort Delaware.

1866-67. Slight repairs made. **66,** 12; **67,** 11.

1869. Proposed to construct earthen battery for guns of largest caliber. **69,** 14.

1870. App. granted for proj. for powerful earthen battery. **70,** 20.

1871. Constr. delayed for want of act of cession of jurisdiction by New Jersey. **71,** 16.

1872. Jurisdiction to site perfected; preparations for active operations begun. **72,** 13.

1873. Wharf nearly completed, temporary buildings built; roads, fences, and dikes worked on: embankment of battery commenced. **73,** 14.

1874. Wharf completed; embankment of parapet continued; magazine begun; dike extended; 2 temporary platforms for 15-inch guns and 3 for 10-inch guns placed. **74,** 16.

1875. Magazine and shelter room completed; 2 wooden platforms laid, and constr. of 2 st. platforms begun; embankment continued; sea wall extended. **75,** 17.

1876. Two st. platforms completed and 2 others begun; 1 magazine built; embankment continued; sea wall rebuilt; fences extended. **76,** 18.

1877. Two st. platforms finished; small amount of work done on sea wall, breast-height wall, and slopes. **77,** 14.

1878. A few minor repairs made. **78,** 17.

1879. Great damage done by October storm; partial repairs made to dike and retaining walls. **79,** 20.

1880-82. Works in poor condition; small necessary repairs made. **80,** 36; **81,** 35; **82,** 32.

1883-84. Part of sea walls repaired and raised; continuation of work urged. **83,** 28; **84,** 33.

1885-86. St. placed along shore where eroded. **85,** 27; **86,** 27.

Part 14, FNH. Mortar Battery at Finns Point, N. J.

1872. $20,000 allotted for 6 mortars. **72,** 24.

1873. Work commenced 1872; terreplein partly embanked, foundations of 2 magazines put in, and side walls brought up 2′; funds derived from the general app. for mortar batteries. **73,** 14.

1874. Sea wall completed; terreplein embanked; masonry of 2 magazines finished; positions of 3 platforms temporarily occupied by 10-inch guns. **74,** 17.

1875-78. No operations for want of funds. **75,** 17; **76,** 18; **77,** 14; **78,** 17.

1879. Report made Nov. 6, 1878, by Col. J. N. Macomb, on the storm of Oct. 23, 1878. The wind blew from the s. and e. with a velocity of 70 m. per hour. The water rose to the unprecedented height of 11 f. 5 in. above l. w. Sea walls, wharf, and buildings partly destroyed. Est. cost of repairs and modifications, $19,560. Record of occasional full tides since 1871. **79,** 240, 243.

1879-81. Résumé of work done; magazines in good condition, but sea wall and embankments badly damaged. **79,** 20; **80,** 36; **81,** 36.

1882-86. Work remains in incomplete condition. **82,** 33; **83,** 29; **84,** 34; **85,** 27; **86,** 27.

Part 15, FNH. Fort Du Pont, Del. (New Fort Opposite Fort Delaware)—Earthen Barbette Battery.

1866-68. Study of defenses for this position to be entered upon. **66,** 12. Commencement of operations deferred. **67,** 11; **68,** 15.

1870. Proj. for earthen battery to mount 20 guns prepared and approved. App. asked for acquisition of site and completion of work. **70,** 21.

1871. Measures taken to acquire site; proposed work specified. **71,** 17.

1872. Site acquired; temporary buildings, etc., erected and wharf begun. **72,** 14.

1873. Wharf and roadway leading to it built; dike nearly completed; embankment of battery commenced. **73,** 14.

1874. Dike completed; right wing of battery partly constr.; wooden platforms for two 15-inch guns laid; embankment in front of battery continued; fencing completed; 3 temporary platforms for 10-inch guns constr. **74,** 17.

1875. Breast-height wall and parapet partly finished; 2 magazines completed; 4 wooden platforms laid; embankment raised for 400′. **75,** 17.

1876. Two magazines completed; breast-height wall continued; torpedo casemate and cable gallery constr.; ramp formed; embankment continued. **76,** 18.

1877. Operations of little importance beyond care and preservation of property. **77,** 14.

1878. Severe storm entirely swept away top of dike; no work done except for care and preservation. **78,** 17.

1879. Résumé of work accomplished to date; fences and br. carried away by storm tide rebuilt; slight repairs executed. **79,** 21.

1880. App. recom. for continuing work; well dug; property cared for. **80,** 37

1881. Wharf repaired. **81,** 36.

1882. Buildings repaired. **82,** 33.

1883-84. No work done. **83,** 29; **84,** 34.

1885-86. Slight repairs made. **85,** 28; **86,** 27.

Part 16, FNH. Mortar Battery Near Delaware City, Del.

1872. $20,000 allotted to fort opposite Fort Delaware for 6 mortars. **72,** 24.

1873. Work commenced in December, 1872. Embankment begun, foundations of magazines put in, and side walls commenced. **73,** 15.

1874. Terreplein formed; 2 magazines nearly completed; parapet nearly embanked; three 10-inch guns mounted temporarily. **74,** 17.

1875–76. No work for lack of funds. **75,** 18; **76,** 18.

1877. Two unfinished magazines completed. **77,** 14.

1878. No work done for lack of funds. **78,** 17.

1879–84. Résumé of work accomplished to date; no work done for lack of funds. **79,** 21; **80,** 37; **81,** 36; **82,** 33; **83,** 30; **84,** 34.

1885–86. Work incomplete and damaged. **85,** 28; **86,** 28.

Part 17, FNH. Battery on Delaware Shore.

1879. Report made Nov. 6, 1878, by Col. J. N. Macomb, on the storm of Oct. 23, 1878. The wind blew from the s. and e. with a velocity of 70 m. per hour. The water rose to the unprecedented height of 11 f. 5 in. The fencing and brs. were carried away and the wharf and roadway injured. A vessel of 80 t. was beached upon the outer slope of the battery. $5,030 was the est. cost of repairs and modification. Record of occasional full tides since 1871. **79,** 238, 242.

Part 18, FNH. Delaware Breakwater (New Fort Near),

1866. Fort to be made subject of study by board. **66,** 12.

1867–68. Work soon to be begun. **67,** 11; **68,** 15.

1869. Proj. to be prepared. **69,** 14.

1873. Extract from laws of Delaware, vol. 14, p. 247—The State of Delaware au. Commission to be app. to meet U. S. Comrs. to arrange for a cession to U. S. of lands on Delaware Bay, s. e. of old U. S. mole * * * the cession to be made on condition that defenses be constructed thereon. **73,** 13.

Part 19, FNH. Three-gun Lift Battery (Battery for Three 12-inch Guns on Disappearing Carriages).

1895. $260,000 allotted for constr. Old works on site removed and contracts entered into for material and plant; drawings nearly completed. **95,** 8. Pre. work done; contracts made for concrete plant, pile drivers, piles, engines, etc.; trolley line constr. and naphtha launch purchased. **95,** 508.

1896. $120,000 withdrawn from allotment. 10,922 c. y. excavated for foundations; 3,810 piles driven; officers' quarters torn down; work suspended during summer; electric plant described **96,** 483.

1897. Proj. for battery of three 12-inch disappearing guns to replace gun-lift battery approved; est. cost, $357,200; pile driving practically completed, 4,582 piles in all being driven; large part of plant used on other work. **97,** 636.

1898. $58,000 allotted to complete concrete foundations, $10,000 withdrawn; remaining piles driven; slip dredged; pile heads cut off; 10,338 c. y. of concrete placed in foundation; sewer built; 3,970 c. y. of sand placed in filling; detailed table given showing cost of concrete and filling. **98,** 641.

1899. Allotment made of $150,000 for constr. of battery; plans remodeled and contracts for materials entered into; concrete work prosecuted vigorously, 13,682 c. y. being placed; ceiling and side-wall constr., ventilating and water-supply systems described; 2,385 c. y. sand and 3,020 c. y. of other filling placed; part of 1 gun carriage received; abstract of proposals given. **99,** 785.

1900. $12,500 allotted to complete battery; concrete work completed, 30,811 c. y. in all being placed; 2,509 sq. y. of superior slope carefully paved; walls faced with tile; asphalt waterproofing placed; filling in front completed, 17,646 c. y. material being used; electric wiring installed, also ventilating system, trolley, drainage and water-supply systems, ammunition cranes, iron stairways and balconies; electric plant moved to permanent power house; tracks laid; parade graded and flagstone pavements laid; many doors hung; 3 guns and carriages received, unloaded, and mounted at total cost of $3,858; old ordnance sold; detailed tables given showing cost of materials and handling and of work. **00,** 847. Ammunition hoists contracted for. **00,** 853.

1901. Boiler and new switchboard set up, electric plant tested, storage battery received, engines overhauled and repaired, chain ammunition hoists completed. **01,** 774. Electric plant cared for, guns and carriages cleaned; detailed statement of amount and cost of work given. **01,** 775, 776.

Part 20, FNH. Battery of Three 10-inch and Three 12-inch Disappearing Guns.

1896. $70,000 allotted for constr.; site surveyed and test pits dug; machinery, derricks, cars, tracks, tools, lumber, and concrete material purchased; wharf and meadow bank repaired; concrete plant constr.; 1,500 c. y. excavated for foundations; 1,706 c. y. concrete placed; wharf extended. **96, 486.**

1897. Est. cost of three 12-inch emplacements, $168,400; of three 10-inch emplacements, $120,000; of parados, $13,750; of road, $3,500; addl. allotment made of $274,680, from which $25,000 withdrawn; wharf described; battery proper completed; general description given of emplacements, 10-inch containing 15,606 c. y. of concrete, and 12-inch 21,918 c. y.; plant for mixing and placing concrete described in detail; composition of concrete, ceiling constr., air spaces in walls described; roadway begun and parados projected; systems for handling ammunition and for electric lighting and power described; three 10-inch guns and carriages mounted; detailed tables given showing distribution of employees on work and cost of labor and materials. **97, 628–636.**

1898. Roadway, electric system, ammunition hoists, latrines, and telephone booths completed; 33,984 c. y. of earth and sand placed in parados; constr. plant torn down and removed; three 12-inch guns and carriages received and mounted; method of mounting described; troops for garrison arrived. **98, 637.**

1899. 6,379 c. y. material placed in parados; work twice interrupted; sluiceway of ditch extended; minor work done on battery; leakage into shot chambers stopped; 5 guns fired, but no target practice; drawing shown of 10-inch ammunition hoist. **99, 782.**

1900. Battery turned over to Artillery Jan. 6, 1899; parados completed, containing 44,500 c. y., and slopes graded; minor work of mainten. done on battery. **00, 842.** Expanded metal ceilings hung to correct dampness in magazines; bracketed gallery erected to connect the 6 platforms; board fence built in rear; tools and supplies purchased. **00, 843.** Slopes of parades repaired; electric plant cared for. **00, 844.**

1901. Various repairs made; trees set out to hide battery; electric lights placed. **01, 771.**

Part 21, FNH. Battery for Two 5-inch R. F. Guns on Balanced Pillar Mounts.

1897. Battery to be built beyond western end of main battery at est. cost of $20,000; excavation for foundations nearly completed. **97, 636.**

1898. Completed in August, 1897; general features of battery and of electric system described; 2 emplacements contain 2,266 c. y. of masonry and embankment 6,944 c. y. of earth; total cost, $19,529; table given showing cost in detail. **98, 639.**

1899. Installation of searchlight plant completed. **99, 784.**

1900. Guns and carriages not yet received; platforms cut down and paved. **00, 842.** Expanded metal ceilings placed in magazines. **00, 843.**

1901. Carriages received and mounted; hoists, wires, beams, etc., painted. **01, 771.**

Part 22, FNH. Mortar Battery.

1897. Battery for sixteen 12-inch mortars to be built at est. cost of $247,180; $175,000 allotted; proposals issued; wharf extended 336′. **97, 638.**

1898. Wharf repaired and extended and transfer br. built; site of battery prepared; methods of handling st., sand, and concrete described; 22,082 c. y. placed in embankment; masonry practically completed, 15,511 c. y. of concrete being placed; electric-lighting system, waterproofing, and pump room completed; 16 carriages and 8 mortars mounted at cost of $4,619; detailed tables given showing cost of materials and handling. **98, 643.**

1899. Height of earth cover reduced and est. of cost revised; $17,500 allotted and $25,344 transferred from another work; storage battery set up; metal doors, telephone circuits, and observation station erected; 91,650 c. y. sand placed in embankment and faced with earth; blast aprons built; arrangement of constr. plant described; battery practically completed; list of expend. given. **99, 790.**

1900. Embankment completed; main drain extended and valve placed at outlet; grounds graded and tracks laid; iron stairway and water tank erected; surface drain laid to prevent flooding of galleries; expanded metal ceilings constr. in magazines and electric fans installed, storage battery used. **00, 858.**

1901. Four mortars mounted; bedplates grouted; storage battery cared for; turned over to Artillery. **01, 779.** $400 allotted for clearing grounds adjacent. **01, 781.**

Part 23, FNH. Two Emplacements for 8-inch Disappearing Guns.

1898. $74,000 allotted for constr. from app. for "National defense;" agreements entered into for open-market purchase of materials required; work begun Mar. 21, 1898; 944 c. y. excavated for foundations; concrete rapidly placed, platforms constr. first, and both guns and carriages mounted by May 18; masonry completed June 8; 8,340 c. y. concrete being placed; waterproofing and electric system completed; expend. given in detail. **98,** 650.

1899. $6,000 withdrawn from allotment; embankment begun and completed, 10,737 c. y. sand and earth being placed in it; electric plant and hoists installed and described; battery reported completed Jan. 1, 1899, and turned over to Artillery January 12; rifles and carriages tested, 1 carriage damaged; cost of battery shown in detail. **99,** 794.

1900. Electric plant cared for; earthen slopes repaired; ironwork painted. **00,** 862.

Part 24, FNH. Two Emplacements for 12-inch B. L. Rifles on Barbette Carriages.

1898. $80,000 allotted for constr. from app. for "National defense;" est. cost, $93,000; delivery of constr. materials arranged for; 1,330 c. y. excavated for foundations; concrete constr. begun and 6,419 c. y. placed; 1 platform completed; waterproofing and embankment begun. **98,** 653.

1899. Both emplacements completed, containing 9,288 c. y. Rosendale and 659 c. y. Portland concrete; general details of constr. given; waterproofing described; latrines constr.; embankment completed, containing 22,278 c. y. material; emplacements completed and turned over to Artillery Jan. 12, 1899; 2 guns and carriages received and mounting begun; cost of battery given in detail. **99,** 797.

1900. $1,500 allotted for mounting guns and carriages; defects discovered in carriages repaired; addl. defects found; mounting completed at cost of $1,208. **00,** 861. Electric plant cared for and repairs made; earthen slopes repaired. **00,** 862.

Part 25, FNH. Emplacements for Two 4.72 R. F. Guns.

1898. $19,750 allotted from app. for "National defense;" temporary platforms erected on barbette of old fort and guns mounted 12 days after arrival; proj. approv. for permanent emplacements; site and general design described; plant set up and materials ordered. **98,** 654.

1899. Foundations excavated, and 206 piles driven; 1,325 c. y. concrete and 7,000 c. y. sand and earth placed; settlement took place in embankment and entrances; battery completed and guns mounted; embankment leveled up; buildings moved out of line of fire; expend. shown in detail. **99,** 800.

Part 26, FNH. Emplacements for 15-pounder R. F. Guns, Two on Left Flank and Two on Right Flank of 12-inch Disappearing Gun Battery.

1899. Allotments made for constr. of $3,800 and $4,000, respectively; sites cleared and small amount of concrete placed. **99,** 790.

1900. Emplacements form part of 12-inch battery; concrete of all emplacements completed except over small part of platforms; pavements, wiring, electric fans, and iron stairways put in place; ammunition hoists contracted for. **00,** 857

1901. Installation of hoists completed (tracing shown); $400 allotted for mounting guns and carriages; work completed. **01,** 776, 777.

Part 27, FNH. Emplacements for Two 5-inch R. F. Guns, Wire Wound, Located on Left Flank of 10-inch and 12-inch Battery.

1900. $17,500 allotted for constr.; derricks set up; constr. materials purchased and stored; proposals given in detail. **00,** 845.

1901. Repairs to wharf; concrete constr. work; sand filling, etc.; detailed statement of work and cost given. **01,** 772, 773.

Part 28, FNH. Emplacements for Two 5-inch R. F. Guns, Wire Wound, Located Between River and Mortar Battery.

1900. $15,900 allotted for constr.; locomotive repaired; small constr. plant erected; 380 c. y. material excavated for foundations; Rosendale and Portland concrete placed, completing masonry of s. emplacement; 4,364 c. y. sand placed under masonry and in front embankment. **00,** 863.

1901. $900 allotted. Battery completed; doors, stairways, platforms, etc., put in place; no guns or carriages yet received; battery turned over to Artillery. **01,** 780. Detailed table showing cost and amount of work. **01,** 781.

Part 29, FNH. Emplacements for Two 15-pounder R. F. Guns.

1901. $16,000 allotted. Constr. work begun plant erected, material excavated for foundation, ceilings of magazines and postern constr. **01,** 777, 778.

1902. Battery completed and turned over; no guns or carriages received. **02,** 695.

Part 30, FNH. Magazine for 3-inch R. F. Guns.

1902. $2,500 allotted for constr. magazines for storage of 500 rounds at entrance to left casemate for 3-inch R. F. guns; designs completed. **02,** 694

Part 31, FNH. Converting Old Magazines Into Casemates.

1901. $3.500 allotted. Excavation grading misc. work. **01,** 773.

1902. Work completed; turned over to Artillery. **02,** 694.

Part 32, FNH. Preservation and Repair.

1898. $325 allotted. Fences repaired; sluice gates ordered. **98,** 650.

1899. Allotments of $945 and $150. Electric plant cared for by skilled mechanic. **99,** 785, 798. $1,150 allotted. River bank, sluices, roadway, and sea wall repaired. **99,** 793.

1900. Under various allotments, tools and supplies purchased, electric plant cared for, river banks and wharf repaired, and other work done. **00,** 843, 844. Wharves filled in, cement purchased, walls of old fort repaired. **00,** 856. Under various allotments, electric plant of 8 and 12 inch battery cared for and repaired, wharf repaired, ironwork of mortar battery painted, earthen slopes repaired. **00,** 862. $300 allotted for repair of river banks; banks placed in good condition. **00,** 865.

1901. $600 allotted for repairs to walls at entrance to 4.72-inch battery; work completed. **01,** 777. Electric-light and power plant cared for; defective boiler tubes replaced. **01,** 779. $4,150 allotted for necessary repairs to river banks, wharves, sea walls, etc. **01,** 783. Old cement shed torn down. **01,** 784.

1902. $930 allotted. Misc. repairs to property. **02,** 698.

Part 33, FNH. Range and Position Finders.

1900. Allotment of $25, tide gauges constr. and station of type B depression range finder near mortar battery changed. **00,** 862.

1901. $11,300 allotted for battery-commander's station; work begun; foundation completed; materials delivered; constr. work in progress. **01,** 782.

1902. Work completed and turned over to Artillery; $295 allotted for fire-control telephone system; work completed. **02,** 696. Constr. of 2 stations for Rafferty range finders begun; brickwork completed; earth embankment not entirely finished. **01,** 782. $8,300 allotted for battery-commander's station for 10-inch battery; work begun; concrete foundations completed. **02,** 696. $161.36 allotted. Work completed. **02,** 697.

Part 34, FNH. Sea Walls and Embankments.

Fort Delaware, Del. Embankment around Fort Delaware Isld. repaired. **66,** 12; **67,** 11; **68,** 15. Large repairs needed, as levees seriously damaged by storm. **70,** 20. Repairs made. **71,** 16. S. dike damaged by severe storm; repaired. **77,** 13. Isld. submerged and dike breached by unprecedentedly high storm tide in October, 1878; damage repaired; est. submitted for raising dikes to 13′. **79,** 20. Dikes restored to original height of 11′. **80,** 35.

Fort Mifflin. R. wall repaired. **68,** 14. 1,700′ reconstr. **72,** 13. Dike breached by storm of October, 1878; damages repaired; height and dimensions reported inadequate; est. submitted for raising and revetting. **79,** 19. Dredgings placed on dikes above naval wharf. **80,** 34. Extensive repairs made to dikes. **82,** 30. Parts of dike thoroughly repaired. **84,** 32; **85,** 25. Meadow banks damaged by severe storms. **96,** 487. Under contract 2,100′ of dike on reservation were rebuilt and repaired, payment of $3,000 being made from R. and H. app. **97,** 639. 280′ of dike repaired, and leaks stopped in main bank. **98,** 657. 1,080′ repaired and 370′ raised and revetted **99,** 794.

Fort Mott, N. J. Dike in front of reservation worked on. **73,** 14. Extended from wharf s. to boundary line; sea wall of mortar battery completed. **74,** 16. 530′ built and 120′ rebuilt. **75,** 17. Sea wall s. of wharf entirely rebuilt on pile foundation. **76,** 18. Great damage done by October storm, 1878; dikes partly repaired. **79,** 20. Part of sea wall repaired and raised. **83,** 28; **84,** 33.

Fort Du Pont. Dike along R. front nearly completed. **73,** 14. Completed. **74,** 17. Top entirely swept away by severe storm rendering further repairs useless. **78,** 17.

Red Bank, N. J. Meadow banks breached by storm. **96,** 488. Dike rebuilt under contract at cost of $2,500. **97,** 639.

Part 35, FNH. Sites.

Measures taken to acquire site at Fort Du Pont (New Fort opposite Fort Delaware) (Fort Mott). 71, 17; 72, 14. Jurisdiction of U. S. to site at Finns Point perfected. 72, 13. Site for defenses at Red Bank, Gloucester County, N. J., acquired, and act giving consent of State of New Jersey to purchase of land approved. 73, 13. Part of Fort Mifflin reservation assigned to Navy Department and another portion leased to Mrs. M. M. Black. 96, 487. Reservation at Red Bank, N. J., leased. 96, 488.

Part 36, FNH. Submarine Mines.

1875. Constr. of torpedo casemate begun at Fort Mifflin. 75, 16.

1876. Fort Mifflin casemate completed. 76, 16. Torpedo casemate and cable gallery constr. at Fort Du Pont. 76, 18.

1885. Torpedoes at Fort Delaware painted and stored. 85, 27.

1887. BE. submitted ests. for 2 mining casemates for Philadelphia. 87, 11.

1891. Proj. prepared and approv. for 1 casemate for Philadelphia. 91, 6.

1892. Allotments made for 2 casemates in 1891; work to be completed in 1892. 92, 8.

1893. One casemate completed at cost of $37,760 and 1 modified at cost of $27,765. 93, 8.

1895. All casemates required completed. 95, 9.

1897. $1,600 allotted for constr. of cable tank; work completed; tank has overhead traveling crane. 97, 637. $7,200 allotted for constr. of fireproof torpedo storehouse of brick; plans approv. and material ordered. 97, 638.

1898. Storehouse completed at cost of $5,588; building described. 98, 649. Casemates and loading room fitted up, dynamite and cables purchased, and everything gotten ready to plant mines upon outbreak of war. Order received April 22; 3 grand groups planted by May 13; planting of mines and apparatus used described; telephones installed; tests made and searchlight installed; condition of mines stated; guard tugs employed. 98, 655.

1899. Total allotment, $22,200. Mines became detached; mines raised and stored; several found to have been injured; 3 blown up; steel mooring ropes broken; condition of mines described; new cable received; reels too large; all parts of torpedo system put in good condition; cost of various operations stated; material cleaned and painted. 99, 802.

1900. Set of cable-testing instruments purchased. 00, 856. $200 allotted for care and preservation of material; searchlights overhauled and stored; inspection of torpedo material made. 00, 865.

1901. $1,500 allotted from "Care and preservation" for lining torpedo cable tank with steel sheets; property cared for, painted, etc. 01, 783.

1902. Work on cable tank completed. 02, 697.

Part 37, FNH. Supplies for Seacoast Defenses.

1901. $3,000 allotted. Materials purchased and turned over. Three thermometer shelters constr.; electric lights installed. 01, 784.

1902. $1,000 allotted. Extensive repairs to electric-plant boiler; electric-light installation completed; water and electric supply mains laid. 02, 698.

FSJ. BALTIMORE, MD., FORTIFICATIONS.

[Note.—Reports on these works from 1903 to 1912 are of a general character only. See the first 15 pages of each annual report from 1903 to 1912.]

Part.	Title.	Period.
1	Contracts	1897–1900
2	Engineering features	....
3	Engineers—Chief of Engineers	1866-1902
4	BE	1882–1887
5	In charge	1866–1902
6	Assistants	1897–1901
7	Forts, etc. (operations, allotments, etc.)	....
8	Fort Carroll	1847–1896
9	Fort McHenry	1875–1900
10	Lazaretto Point, opposite Fort McHenry	1870–1872
11	Rock Point, Md	1897–1898
12	Site 1—emplacement, 12-inch gun and three 8-inch guns	1897–1901
13	Two emplacements, 4.7-inch R. F. guns	1898–1900
14	Two emplacements, 15-pounder R. F. guns	1899–1901
15	Site 2—two emplacements, 12-inch B. L. rifles, barbette carriages	1898–1900
16	Two emplacements, 5-inch R. F. guns, balanced-pillar mounts	1899–1902
17	Two emplacements, 15-pounder R F. guns	1899-1901
18	Remodeling old work	1901–1902
19	Site 3—emplacements, eight 12-inch mortars	1897–1902
20	Two emplacements, 5-inch R. F. guns	1897–1901
21	Two emplacements, 12-inch B. L. rifles, disappearing carriages	1898–1901
22	Two emplacements, 6-inch B. L. rifles, disappearing carriages	1899–1901
23	Two emplacements, 15-pounder R. F. guns	1899–1900
24	Two emplacements, 15-pounder R. F. guns	1900–1901
25	Site 4—two emplacements, 6-inch B. L. rifles, disappearing carriages	1899–1901
26	Miscellaneous (surface drainage; place storage magazine; roadway; civilian electricians)	1901–1902
27	Preservation and repairs	1899–1902
28	Range and position finders	1899–1902
29	Searchlights	1901
30	Sea walls and embankments	1894–1902
31	Sites	1895–1902
32	Submarine mines	1893–1902
33	Supplies	1901–1902

Part 1, FSJ. Contracts.

1897. One 12-inch and three 8-inch gun emplacements, with wharf, $122,064.46. Mortar battery for eight 12-inch mortars, with wharf, $91,-513.31. **97,** 646, 649.

1898. Electric-lighting plant, mortar battery, $2,820. **98,** 662. Two 5-inch R. F. gun battery. $15,798.50. **98,** 663.

1899. Sea walls and embankments at sites 1 and 3, $24,967. Portland cement. 1,785 barrels, $2.18 per barrel. Rosendale cement, 7,150 barrels, 95c per barrel. Brick, $13 to $45 per M. **99,** 810. Torpedo storehouse, $3,293. **99,** 817. Wharf, $5,481.50. **99,** 818.

1900. Electric-lighting plant, $1,650. **00,** 866.

Part 2, FSJ. Engineering Features.

Cement, slag, for concrete. **98,** 665.

Concrete, cost per c. y. **98,** 659, 661; **99,** 819, 820, 821; **00,** 871, 874. Preventing infiltration of water. **02,** 2463.

Dampproofing. Analysis of the problem. **03,** 2400. Air-spacing experiments. **02,** 2462. Asphaltum; unsatisfactory methods of using. **02,** 2464 (pl.). Copper sheeting. **02,** 2464. Fill; care required in forming. **02,** 2462. Magazines and passages. **02,** 2400, 2464 (pl.); **03,** 2404 (pl.). Magnesia lumber; use of. **02,** 2464. Ventilation, experiments with. **02,** 2461.

Emplacements. Sections. **02,** 2464 (pl.).

Excavation, cost per c. y. **98,** 659, 661.

Grading, cost per c. y. **98,** 659.

Granolithic concrete. **98,** 660; **00,** 871, 874.

Plant, description of. **98,** 664, 666.

Sand containing water under pressure, method of laying concrete on. **97,** 647.

Waterproofing magazines. **98,** 661, 664; **99,** 818, 819; **00,** 866.

Part 3, FSJ. Engineers.

Chief of Engineers. **Rs., 66,** 12; **67,** 11; **68,** 15; **69,** 14; **70,** 21: **71,** 17; **72,** 14; **73,** 15; **74,** 17; **75,** 18; **76,** 19; **77,** 14; **78,** 18; **79,** 22; **80,** 37; **81,** 37; **82,** 34; **83,** 30; **84,** 35; **85,** 28; **86,** 28; **93,** 8; **94,** 14; **95,** 15; **96,** 15, 488; **97,** 15, 639; **98,** 21, 658; **99,** 23, 806; **00,** 21, 866; **01,** 622; **02,** 699; **03,** 9; **04,** 5, 10; **05,** 5; **06,** 5; **07,** 5; **08,** 9; **09,** 10; **10,** 12; **11,** 8; **12,** 7.

Part 4, FSJ. Board of Engineers.

Constituted to consider and report upon the condition of fortifications and what number, if any, could be dispensed with. **R., 82,** 421; **87,** 11.

Part 5, FSJ. Engineers in Charge.

Capt. C. N. Turnbull, 1866.
Col. W. P. Craighill, 1866–93.
Maj. J. G. Parke, 1868.
Col. J. H. Simpson, 1868–70.
Lt. Col. J. D. Kurtz, 1870.
Capt. C. P. Phillips, 1878.
Capt. T. Turtle, 1888.
Col. P. C. Hains, 1896–99.
Lt. C. W. Kutz, 1896–1900.
Lt. Col. O. H. Ernst, 1900–02.
Col. Peter C. Hains, 1902.

Part 6, FSJ. Assistant.

Lt. C. W. Kutz, 1897–1901.

Part 7, FSJ—

FORTS AND BATTERIES.

Part 8, FSJ. Fort Carroll.

1847. Work begun. **80,** 38.

1866–67. Preservation. **66,** 13; **67,** 12.

1868. Work is completed on fronts 1, 2, 3, 4, and 5 up to the springing line of casemate arches of second tier. **68,** 15.

1869. Temporary wharf repaired. **69,** 14.

1870. Preservation and repair. **70,** 21.

1871. Observations made to determine the direction and force of the surface and subsurface currents, for use in placing explosives. **71,** 17.

1872–73. Preservation. **72,** 14; **73,** 15.

1874. One wooden center pintle platform for 15-inch gun laid and temporary parapet erected in front of it. One 15-inch gun mounted on center pintle carriage; minor repairs. **74,** 18.

1875–78. Preservation and repair. **75,** 18; **76,** 19; **77,** 15; **78,** 18.

1879. Proj. for completion, by BE. Preservation and repair. **79,** 23.

1880–82. Preservation and repair. **80,** 38; **81,** 38; **82,** 35.

1883. About 8,000 sq. f. of graveled felt roofing placed on casemate: and minor repairs. **83,** 31.

1884–86. Care and preservation. **84,** 36; **85,** 29; **86,** 29.

Part 9, FSJ. Fort McHenry.

1775. Fortifications begun. **80,** 37.

1794. Present work built. **80,** 37.

1866. Reinforcing pintle centers in exterior battery; substitution of low for high traverse circles; constr. of magazines and traverses. The exterior battery platforms ready for 15-inch guns. **66,** 12.

1867. Water battery ready for armament; magazines, bombproofs, and traverses nearly completed. Minor work **67,** 11.

1868. New work of parapets of water battery and magazine coverings consolidated; glacis of water battery re-formed; new drains cut for magazines; and minor work **68,** 15.

1869. Repairs to terreplein of water battery and ditch of main work; brick hoods of magazines increased; defective drains in main work relaid; and minor work on slopes. **69,** 14.

1870. Minor repairs to slopes. **70,** 21.

1871. Wharf rebuilt and minor work; observations made to determine the direction and force of the surface and subsurface currents for use in placing explosives. **71,** 17.

1872. $21,000 app. Preservation and repair. **72,** 14.

1873. $25,000 app. Work begun on new, large exterior battery; minor repairs to slopes of water battery. **73,** 15.

1874. Work on parapet and heavy embankment for the terreplein on front 4 of new earthen battery; concrete work of 3 magazines; and completing drainage. **74,** 17.

1875. $20,000 app. Minor repairs to revet. of parapet of new battery and exterior battery of main work. **75,** 18.

1876. Sand parapet extended; sand covering placed on 3 magazines; terreplein partly graded; and minor repairs to slopes. **76,** 19.

1877–78. Preservation and repair. **77,** 15; **78,** 18.

1879. Breaches in sea wall repaired. Preservation and repair. **79,** 22.

1880. Preservation and repair. **80,** 38.

1881. Repairs to sea walls, slopes, and drains. **81,** 37; **82,** 34.

1883. Repairs to slopes, etc. **83,** 31.

1884. Repairs to scarps, slopes, and drains. **84,** 35.

1885–86. Repairs to slopes, drains, gutters, pavements, and retaining wall of ramp; and building wire fences. **85,** 29; **86,** 28.

1895–96. Work on sea wall completed. **95,** 15; **96,** 489.

1897. Grounds back of sea wall graded and seeded. **97,** 640.

1898. Minor repairs. **98,** 658.

1899. $1,000 allotted for preservation and repair. **99,** 806, 818.

1900. Preservation and repair. **00,** 866.

Part 10, FSJ. Lazaretto Point, Opposite Fort McHenry.

1870. Site selected. **70,** 21.

1871. Observations made to determine the direction and force of the surface and subsurface currents for use in placing explosives. **71,** 17.

1872. $13,000 app. To be transferred to Fort McHenry. **72,** 14.

Part 11, FSJ. Rock Point, Md.

1897. Site acquired by condemnation proceedings; $1,400 allotted for wharf 1,080′ long; completed. **97,** 649.

1898. Marking boundaries with concrete monuments and inclosing the property with wire fence. **98,** 666.

Part 12, FSJ. Site 1.—Emplacement for One 12-inch Gun and Three 8-inch Guns.

1897. Land acquired and $143,800 allotted for fortifying same; work begun by contract; 13,681 c. y. excavated and placed in parapet and 1,682 c. y. concrete laid; work on sea wall. **97,** 641.

1898. $3,200 allotted for mounting guns and carriages; moving from wharf done by contract; battery completed, including ammunition service and electric plant; summary of work; total cost, $143,800. **98,** 659.

1899. Battery turned over to Artillery; repairs to slopes and power plant; exhaust fans installed to prevent dampness. **99,** 806, 818.

1900. Seven electrical exhaust fans installed; roadway built and minor repairs. **00,** 866.

1901. $5,608.57 allotted. System of metal ceiling and drainage partially installed to prevent seepage and condensation. **01,** 699.

Part 13, FSJ. Site 1.—Two Emplacements for 4.7-inch R. F. Guns.

1898. $15,000 allotted. Work begun in April, 1898, under oral agreement, by same firm that built 8-inch and 12-inch battery, and practically completed May 10, 1898. Summary and cost of work. **98,** 660.

1899. Two ammunition hoists installed and guns mounted. Battery turned over to the Artillery. **99,** 806, 819.

1900. Repairs to electric plant and slopes. **00,** 867.

Part 14, FSJ. Site 1.—Two Emplacements for 15-pounder R. F. Guns.

1899. $6,610 allotted. Work begun in April and practically completed; no guns on hand. Waterproofing. Work on sea walls, grading grounds, and range finder erected. **99,** 807, 819.

1900. Minor details of battery finished; no guns or mounts on hand. Total cost, $6,860. **00,** 867.

1901. Armament received and mounted by troops. **01,** 785.

Part 15, FSJ. Site 2.—Two Emplacements for 12-inch B. L. Rifles on Barbette Carriages.

1898. $80,000 allotted. Work begun by hired labor; description of battery and plant. Both platforms built and 2,500 c. y. of concrete placed. Character of site necessitated a number of modifications in type plans. **98,** 666.

1899. Battery completed, power house built, carriages mounted, but no guns on hand. **99,** 812, 819.

1900. Guns mounted and fired to test stability of platforms. Battery turned over to the Artillery. Repairs to earth parapet and electric plant. Cost of battery, including mounting guns and carriages, $82,647.29. **00,** 868.

Part 16, FSJ. Site 2.—Two Emplacements for 5-inch R. F. Guns on Balanced Pillar Mounts.

1899. $12,300 allotted. Work begun and completed, except mounting guns and carriages. Summary and cost of work. **99,** 812, 819.

1900. Grounds graded and seeded. No complete carriage or guns on hand. **00,** 868.

1901. Work completed; turned over Aug. 1, 1900. **01,** 786.

1902. Top of 1 carriage mounted during year; battery now completed, with exception of guns. **02,** 700.

Part 17, FSJ. Site 2.—Two Emplacements for 15-pounder R. F. Guns.

1899. $7,600 allotted. Work begun in March and completed, except minor details; no guns or mounts received. **99,** 813, 820.

1900. Stairway and rails erected. Grounds graded and seeded; flag walks placed in rear of battery. No guns or mounts on hand. Cost of battery without armament, $8,706.52. **00,** 868.

1901. Guns mounted; emplacements turned over. **01,** 786.

Part 18, FSJ. Site 2.—Remodeling Old Work,

1900. \$12,800 allotted for removing part of old masonry above the crest line of modern batteries to make it conform, both in appearance and utility, to the modern emplacements; work in progress. **00,** 869.

1901. \$4,925 allotted. Pavement and runway constr.; casemate piers refaced; work still in progress. **01,** 787.

1902. Top of wall finished off with cement mortar; flashings filled, etc., finishing up work. **02,** 700.

Part 19, FSJ. Site 3.—Emplacements for Eight 12-inch Mortars.

1897. \$134,637.25 allotted. Site acquired; work begun by contract; wharf completed and 6,591 c. y. excavated and placed in slope and 1,403 c. y. of concrete placed. **97,** 647.

1898. Description of battery. All concrete mixed by hand, guns and carriages mounted, and battery completed under contract. Summary and cost of work. Total cost, \$113,000. **98,** 660.

1899. Electric plant installed and battery wired by contract; battery turned over to the Artillery. Preservation and repair. **99,** 813, 820.

1900. Repairs to electric light and power plant. **00,** 869.

1901. \$13,500 allotted for placing layer of asphalt all about sides and roofs of magazine shot rooms, passages, etc.; work in progress. **01,** 788.

1902. Dampproofing work continued. **02,** 701.

Part 20, FSJ. Site 3.—Two Emplacements for 5-inch R. F. Guns.

1897. Work to be done by contract. **97,** 647.

1898. \$17,400 allotted. Contract price, \$15,798.50. Work begun Aug. 10, 1897; completed June 1, 1898. Description of battery. No carriages on hand. **98,** 663.

1900. Carriages received and mounted; roadway built; no guns on hand. Total cost, \$17,400. **00,** 870.

1901. Turned over Oct. 27, 1900. **01,** 788.

Part 21, FSJ. Site 3.—Two Emplacements for 12-inch B. L. Rifles on Disappearing Carriages.

1898. \$100,000 allotted. Work begun by hired labor. One platform completed. Description of plant, water supply, and constr. **98,** 664.

1899. \$18,500 allotted. Guns mounted, elevators installed, battery wired, and completed in all details and turned over to the Artillery; cost of battery, \$113,500. Handling and mounting 2 guns and carriages, \$4,561.12. **99,** 814, 820.

1900. Repairs to electric plant. Defects in carriages corrected at the expense of the Ordnance Department. **00,** 870.

1901. Base for range finders set. **01,** 788.

Part 22, FSJ. Site 3.—Two Emplacements for 6-inch B. L. Rifles on Disappearing Carriages.

1899. \$47,000 allotted. Excavation begun. **99,** 815.

1900. Carriages mounted; grounded graded and seeded. No guns on hand. Battery turned over to the Artillery. Cost to date, \$37,933.91. Summary and cost of work. **00,** 871.

1901. Trolleys and blocks put in and soap-and-alum wash applied to platforms. **01,** 788.

Part 23, FSJ. Site 3.—Two Emplacements for 15-pounder R. F. Guns.

1899. $11,345 allotted. Work completed, except earth parapet and stairway. Summary and cost of work. **99,** 815, 820.

1900. Parapet filled in and sodded; stairway and rail erected; grounds graded and seeded. No guns or mounts on hand. Battery turned over to the Artillery. Total cost, $10,445. **00,** 870.

Part 24, FSJ. Site 3.—Two Emplacements for 15-pounder R. F. Guns.

1900. $10,000 allotted. **00,** 872.

1901. $460 allotted. Emplacements and roadway constr.; turned over to Artillery. **01,** 788.

Part 25, FSJ. Site 4.—Two Emplacements for 6-inch B. L. Rifles on Disappearing Carriages.

1899. $50,000 allotted. Wharf built by contract. Plant installed. **99,** 817, 821.

1900. Battery completed, except wiring and furnishing trolleys and blocks; carriages mounted and the battery turned over to the Artillery. Total cost to date, $48,255.54. Summary and cost of work. **00,** 874.

1901. Trolleys and blocks put in. **01,** 790.

Part 26, FSJ. Miscellaneous.

Surface drainage. $295.21 allotted for constr. a system of surface drains on reservation 1; work completed. **01,** 785.

Peace storage magazine. Plans submitted. **01,** 789.

Roadway. $3,316.50 allotted to constr. road between mortar battery and 12-inch battery; nothing done. **01,** 789. Constr. completed. **02,** 702.

Civilian electricians. $1,650 allotted for pay for services. **02,** 703.

Part 27, FSJ. Preservation and Repair.

1899. $1,000 allotted. **99,** 806. General repairs to batteries at site 1. **00,** 868.

1900. $1,000 allotted. General repairs, site 2. **00,** 869. $1 500 allotted for repairs to site 3. **00,** 873. $320 allotted for site 4. **00,** 875.

1901. $1,700 allotted for reservation 1; repairs made. **01,** 786. $1,200 allotted for reservation 2; repairs etc. made. **01,** 787 $2 500 allotted for reservation 3; misc. repair work **01,** 790. $650 allotted for reservation 4; mainten. work. **01,** 791.

1902. Reservation 1; repairs to wharf power plants, sea wall etc. **02,** 700 Reservation 2; repairs. **02,** 701. $500 allotted. Reservation 3; repairs to various works **02,** 703. Reservation 4; repairs. **02,** 703.

Part 28, FSJ. Range and Position Finders.

1899. $50 allotted erecting range finders at sites 1 and 3. **99,** 807.

1902. $6,000 allotted for reservation 2; battery-commander's station: excavation made; foundations built up: ironwork erected; tower nearly completed. **02,** 700. $200 allotted for reservation 3; concrete bases for Rafferty range finders abandoned; structural iron bases substituted. **02,** 702 $14.600 allotted for 2 battery-commander's stations reservation 3; instrument column, shields, and framework erected. **02,** 702.

Part 29, FSJ. Searchlights.

1901. Proj. submitted; est. cost $78,821.06. **01,** 791.

Part 30, FSJ. Sea Walls and Embankments.

Fort McHenry. Est. cost of repairs to sea wall, $10,000. **94,** 14. Wall in rear of cemetery, 227′ long, completed; rear of site of fort, about 808′ long, in progress. **95,** 15. $8,591.51 allotted. Sea wall 808′ long completed. **96,** 489. $13,750 allotted. Sea wall built by contract; cost, $14,214.90. **97,** 640.

1901. $3,000 allotted for reinforcing wall on reservation 1 with concrete; 1 200 l. f. done **01,** 786. $18,000 allotted for filling behind concrete wall; 9,800 c. y. excavated and placed in fill, and 200 l. f. foundation placed for extension of wall. **01,** 789. Reservation 4; $3,000 allotted. 1,266 l. f. wall, 2′ wide at top, 4′ wide at base, 5′ high, constr. **01,** 790.

1902. Reservation 1; 400′ built during year completed; concrete wall. **02,** 700. Reservation 3; riprap foundation for wall placed; fill completed; sod placed to prevent washouts. **02,** 702. Reservation 4; fill work finished; swamp sod placed behind wall to prevent washouts. **02,** 703.

Hawkins Point. $7,000 allotted for repairs to sea wall; work in progress. **97,** 641. 3,049 c. y. of riprap and 4,476 c. y. of oyster shells and earth filling placed; cost, $6,645.40. **98,** 659. $35,000 allotted for sea walls at sites 1 and 3 under contract; some work. **99,** 807, 821. 1,600 c. y. of riprap placed on face 6. **99,** 820. Sea wall at site 1; completed by hired labor (contract expired). **00,** 867. Sea wall at site 3 completed by hired labor. **00,** 872. $8,000 allotted for sea wall at site 4. **00,** 875.

Part 31, FSJ. Sites.

Three sites needed for batteries. **95,** 14. $46,500 allotted for sites at North Point, 28½ acres; Hawkins Point, 12.47 acres; and Rock Point 100 acres. **96,** 489. $4,500 paid for land at Hawkins Point. **97,** 641. Site at North Point purchased, $13,500 paid. **97,** 647. $27,500 paid for 100 acres of land at Rock Point **97,** 649. $155.55 allotted for survey, reservation 1; made. **02,** 700.

Part 32, FSJ. Submarine Mines.

1893. Mining casemate nearly completed. **93,** 8.

1898. Mines planted. **98,** 22.

1899. Mining casemate at site 2 waterproofed. $6,240 allotted for operating mine field and removal and storage of torpedo material. **99,** 813. $6,670 allotted for mining casemate; nearly finished. Summary and cost of work. **99,** 816, 821. $5,000 allotted for torpedo storehouse under contract. **99,** 816. $3,500 allotted for cable tank; completed and crane erected. Summary and cost of work. **99,** 817, 821.

1900. Est. of $9,550 for mining casemate at site 1 approv.; no funds. **00,** 868. Casemate at site 3 practically completed and torpedo storehouse built. **00,** 872. $500 allotted for site 4; no expend., as torpedo material was stored and cared for by Engr. force. $1,000 allotted for supplies for seacoast defenses; no requisition as yet. **00,** 875

1901. $9,000 allotted for constr. mining casemate, reservation 1; excavation made; concrete brought up to height of roof beams. **01,** 785. Reservation 3; telephone conduit between casemate and storehouse completed; other misc. work done. **01,** 789. Storehouse and cable tank completed; turned over to Artillery. **01,** 789. Material cared for. **01,** 791.

1902. $1,202.29 allotted for mining casemate, reservation 1; work completed. **01,** 699.

Part 33, FSJ. Supplies for Seacoast Defenses.

1901. $1,400 allotted for enlarging coal bin in rear of 12-inch emplacement. **01,** 785. $1 000 allotted. Supplies purchased and distributed. **01,** 791.

1902. Work of enlarging coal storage completed. **02,** 699. $363.04 allotted. Supplies purchased and furnished. **02,** 704.

FSK. WASHINGTON, D. C., FORTIFICATIONS.

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Part.	Title.	Period.
1	Contracts	1896–1902
2	Engineering features	....
3	Engineers—Chief of Engineers	1866–1912
4	BE	1882–1889
5	In charge	1866–1902
6	Assistants	1892–1899
7	Forts, etc. (operations, allotments, etc.)	1816–1902
8	Potomac R., Md.—Fort Washington	1816–1886
9	Fort Foote	1862–1902
10	Left bank—2-gun battery	1892–1900
11	Two 10-inch gun emplacements	1896–1900
12	R. F. battery—two 4-inch Driggs-Schroeder guns	1898–1900
13	Two emplacements, 10-inch guns, disappearing carriages	1898–1900
14	Battery E, eight 12-inch mortars, B. L. rifles on carriages, model 1896	1899–1902
15	Battery, two 15-pounder R. F. guns	1899–1901
16	Battery, two 6-inch R. F. guns	1899–1902
17	Right bank—3 emplacements, 8-inch guns, disappearing carriages	1897–1902
18	Emplacements, two 5-inch R. F. guns	1899–1902
19	Battery, three 15-pounder R. F. guns	1900–1902
20	Miscellaneous (electric lighting, etc.; passageways; mounting guns, etc.; obstructions in Potomac R.; telephone booths; experimental parapets, etc.)	1866–1902
21	Preservation and repair	1898–1902
22	Range and position finders	1898–1902
23	Sites	1892–1893
24	Submarine mines	1891–1899
25	Supplies	1900–1902

Part 1, FSK. Contracts.

1896. Small st., $1.88 per c. y.; granolithic st., $2.08 per c. y.; brick, $12 per M; Rosendale cement, 99¼¢ per barrel; Portland cement, $2.87 per barrel. **96,** 490.

1897. Rosendale cement, 4,000 barrels, 84½¢ per barrel. **97,** 652. Two emplacements for 8-inch guns, including wharf, $58,683.96. **97,** 653.

1898. Natural cement, 4,000 barrels, 61¢ per barrel; sand, 1,000 c. y., 40¢ per c. y.; pebbles, 1,000 c. y., 59¢ per c. y.; riprap st., 1,300 c. y., $1.35 per c. y.; broken st., 1,550 c. y., $1.50 per c. y. **98,** 672. Electric light and power plant, $7,683.92; I beams, 1,423 pounds, 2¼¢ per pound. **98,** 674, 678.

1900. Rosendale cement, 5,000 barrels, $1.12½ per barrel. **00,** 881.

1901. Iron and steel roofs, $1,185; stairs, railings, and ladders, $1,460.43; tram rails, trolleys, and hoists, $1,450; furnishing and erecting lifts and cranes, $1,730. **01,** 798. Furnishing and delivering stairs, $180; roof, $395.

1902. Installing electric plants, $4,718, $2,895, and $8,975. **02,** 707, 710.

Part 2, FSK. Engineering Features.

Concrete, settlement of. **00,** 877.

Experimental parapet. **98,** 668; **99,** 826 **00,** 880.

Waterproofing. **98,** 669.

Part 3, FSK. Engineers.

Chief of Engineers. **R., 66,** 13; **67,** 12; **68,** 15; **69,** 14; **70,** 21; **71,** 17; **72,** 14; **73,** 15; **74,** 18; **75,** 19; **76,** 20; **77,** 16; **78,** 19; **79,** 23; **80,** 39; **81,** 38; **82,** 35; **83,** 31; **84,** 36; **85,** 29; **86,** 29; **91,** 5; **92,** 7; **93,** 8; **94,** 10; **95,** 9; **96,** 16, 490; **97,** 15, 650; **98,** 22, 667; **99,** 24, 822; **00,** 22, 876; **01,** 23; **02,** 23; **03,** 9; **04,** 5, 9; **05,** 5; **06,** 5; **07,** 5; **08,** 9; **09,** 10; **10,** 12; **11,** 8; **12,** 7.

Part 4, FSK. Board of Engineers.

Constituted, 1882, to consider and report upon the condition of fortifications, and what number, if any, could be dispensed with. **R., 82,** 421; **87,** 11; **89,** 6.

Part 5, FSK. Engineers in Charge.

Maj. B. S. Alexander, 1866.
Maj. J. A. Tardy, 1867.
Col. H. Brewerton, 1868.
Maj. N. Michler, 1870.
Lt. Col. J. D. Kurtz, 1870.
Lt. Col. W. P. Craighill, 1870–83.
Capt. C. B. Phillips, 1878.
Capt. T. Turtle, 1883.
Lt. Col. P. C. Hains, 1883–92.
Maj. L. C. Overman, 1892.
Capt. T. Turtle, 1892.
Maj. C. E. L. B. Davis, 1892–96.
Lt. Col. C. J. Allen, 1896–1902.
Maj. W. M. Black. 1902.

Part 6, FSK. Assistants.

Lt. G. A. Zinn, 1892–94.
Lt. D. DuB. Gaillard, 1895–96.
Lt. G. P. Howell, 1896–97.
Lt. J. J. Morrow, 1897–99.

Part 7, FSK—

FORTS AND BATTERIES.

Part 8, FSK. Fort Washington, Potomac River, Md.

1816. Work begun. **80,** 39.

1866. The necessary ameliorations to be considered by BE. **66,** 13.

1870. Importance of fort. Modification plans being prepared. **70,** 22.

1871. Observations made for determining the direction and force of the surface and subsurface currents, for use in placing explosives. **71,** 18.

1872. $21,000 app. Projs. of earthen barbette batteries immediately n. and s. of main work, as well as modification plans of existing water battery, prepared. **72,** 15.

1873. $25,000 app. Work begun in March on removal of old demilune not required by new plans; completion of exterior supporting bank of earth for sand parapet; excavations for traverse magazines made, and some concrete work. **73,** 16.

1874. Work on demilune, masonry of traverse magazines, and embankments; 2 platforms between traverse magazines completed, and work on other platforms. Title to an adjoining 300-acre tract nearly perfected. **74,** 19.

1875. Pintles set in 4 new platforms; minor work and repairs; adjoining tract of land purchased. Survey of entire territory completed. **75,** 19.

1876. Repairs of wharf, cribwork, and minor repairs. **76,** 20.

1877. Repair of br. at sally-port entrance, wharf, fences, and cribwork. **77,** 16.

1878. Revised proj. prepared. Repairs of wharf and roofs of 2 principal magazines. **78,** 20.

1879. Repair of wharf, etc. **79,** 24.

1880–85. Preservation and repair. **80,** 39; **81,** 39; **82,** 37; **83,** 32; **84,** 37; **85,** 30.

1886. Traverse rails and pintle plates for four 15-inch gun platforms laid. Repair of slopes, magazines, and fences. **86,** 30.

Part 9, FSK. Washington, D. C.—Fort Foote, Potomac River, Md.

1862. Work begun. **80, 39.**

1870. Importance of fort. Survey and minor repairs of ground exterior to the existing works. **70, 21.**

1871. Wharf rebuilt. Observations made for determination of the direction and force of the surface and subsurface currents for use in placing explosives. **71, 17.**

1872. $21 000 app. Modification plans approv.; arrangements made for purchase of site. **72, 14.**

1873. $25,000 app. Site acquired and work begun in April on completion of wharf and necessary structures for execution of work; earth embankment for new parapet nearly completed. **73, 15.**

1874. Work on earth embankments and slopes, drains masonry in magazines and wing wall; wharf extended; foundations of 4 front pintle gun platforms completed. **74, 18.**

1875. Completing platforms; work on masonry of magazines. Land acquired to afford the garrison an outlet to the Piscataway Road. **75, 19.**

1876. Repairs of cribwork and wharf. **76, 20.**

1877. Two new front pintle 15-inch gun platforms provided with traverse circles, and a temporary wooden breast height built in front. **77, 16.**

1878–85. Preservation and care. **78, 19; 79, 23; 80, 39; 81, 38; 82, 36; 83, 32; 84, 37; 85, 30.**

1886. Traverse rails and pintle plates laid for two 15-inch guns; repair o. quarters, roads, and slopes. **86, 30.**

1901. $50 allotted. Repairs to wharf and roadway. **01, 791.**

1902. $50 allotted. Minor repairs. **02, 704.**

Part 10, FSK. Left Bank of Potomac River, Md.—Two-gun Battery.

1892. $117,150 allotted, 1891. Plans approv.; work begun in September, 1891; wharf built, plant erected, and excavation in progress. **92, 4, 7.**

1893 Excavation completed; concrete work begun. **93, 8.**

1894. Two emplacements completed, awaiting decision of details of carriages. **94, 10.**

1896. $20,826 allotted, 1895. Emplacements nearly completed. Total cost to date, $141,403.03. **96, 16, 491.**

1897. Guns mounted and battery completed. **97, 651.**

1899. Electric-light plant installed and repairs of granolithic covering on superior slope. **99, 822.**

1900. Battery turned over to the commanding officer July 6, 1899. **00, 876.**

Part 11, FSK. Left Bank of Potomac River, Md.—Two 10-inch Gun Emplacements.

1896. $50,000 allotted. Work begun on 1 emplacement. **96, 16.**

1897. Emplacement practically completed and gun mounted in May, 1897, on a disappearing carriage, L. F. model 1894. $41,500 allotted for another emplacement, which was begun in June; excavation nearly completed. **97, 652.**

1898. Gun mounted on a disappearing carriage, L. F. model, 1896, and battery practically completed; minor work required. **98, 667.**

1899. Stairs and railways erected; observation station for type B range finder built; cement floor placed in dynamo room; tile partition built between boiler and dynamo room; and electric plant installed. **99, 822.**

1900. Battery turned over to the commanding officer July 6, 1899. **00, 876.**

Part 12, FSK. Left Bank of Potomac River, Md.—Rapid-fire Battery—Two 4-inch Driggs-Schroeder Guns.

1898. $13,150 allotted. Work begun in May; old magazine removed. concrete floors of both magazines and about half that in walls of 1 magazine placed; both guns being mounted. **98, 670.**

1899. Mounting of guns completed and battery completed. Summary of work. **99, 824.**

1900. Battery turned over to the commanding officer July 6, 1899. **00, 876.**

Part 13, FSK. Left Bank of Potomac River, Md.—Two Emplacements for 10-inch Guns on Disappearing Carriages.

1898. $92,300 allotted. Work begun in March; concrete work two-thirds completed. **98,** 670.

1899. $1,000 allotted. Guns and carriages mounted and battery completed. Summary of work. **99,** 823.

1900. Battery turned over to the commanding officer July 6, 1899. **00,** 876.

Part 14, FSK. Left Bank of Potomac River, Md.—Battery E, for Eight 12-inch Mortars, B. L. Rifles on Carriages, Model of 1896.

1899. $113,000 allotted. Work begun in August, 1898, excavation completed. 4,478 c. y. concrete placed and 16 400 c. y. earth placed in embankment. Battery about half completed. **99,** 824.

1900. Concrete work on magazines and parapets completed; asphalt covering of magazine placed; no mortars received; base rings to be taken up and releveled. Summary and cost of work. **00,** 877.

1901. $4,000 allotted. About 12% of constr. work remained to be done; completed: electric lights installed and mortar mounting accepted **01,** 792 Base rings reset; platforms tested. **01,** 793.

1902. Electric-light plant installed **02,** 705.

Part 15, FSK. Left Bank of Potomac River, Md.—Battery for Two 15-pounder R. F. Guns.

1899. $9,500 allotted. Work begun in March on excavation and placing concrete. **99,** 825.

1900. Work completed except gun platforms, awaiting arrival of mounts. **00,** 879.

1901. Railings set. **01,** 794.

Part 16, FSK. Left Bank of Potomac River, Md.—Battery for Two 6-inch R. F. Guns.

1899. $59,180 allotted. Work begun in June. **99,** 826.

1900. Difficulty in obtaining material; 395 c. y. concrete placed, 3,000 c. y. excavation and embankment made; about 25% of work done. **00,** 878.

1901. $5,450 materials received; installation ammunition hoists, concrete constr. completed; base rings set, embankments built, roadway and gutters constr.; battery 92% completed. **01,** 794.

1902. Electric conduit and trolley beams installed; roadway and gutters finished; work completed; carriages mounted, guns received. **02,** 705.

Part 17, FSK. Right bank of Potomac River, Va.—Three Emplacements for 8-inch Guns on Disappearing Carriages.

1897. $106,125 allotted. Work to be done under contract begun in January. 11,623 c. y. excavated, 5,537 c. y. placed in embankment, drainage system put in. **97,** 652.

1898. Wharf completed. Excavation and concrete work completed. $1,850 allotted for mounting guns and carriages; completed. Method of work described. $120 allotted; 3 telephone booths built. **98,** 676.

1899. Completing details of machinery, doors, roadway; covering the embankment with soil. **99,** 832

1900. Battery turned over to the commanding officer Jan. 13, 1900. **00,** 885.

1901. Minor repairs. **01,** 798.

1902. Electric light and power plant installed. **01,** 704.

Part 18, FSK. Right Bank of Potomac River, Va.—Emplacements for Two 5-inch R. F. Guns.

1899. $14,500 allotted. Work begun in November, 1898. Excavation and concrete work in progress. Platforms delayed because of nondelivery of the gun mounts. **99,** 832.

1900. Work suspended; about three-fourths completed; funds exhausted; no mounts received. **00,** 884.

1901. $2,700 allotted. Gun platforms and parapets finished; cylinders of gun mounts set; batteries practically finished. **01,** 798.

1902. Erection of railing and general care of batteries; guns received, 1 mounted. **02,** 708.

Part 19, FSK. Right Bank of Potomac River, Va.—Battery for Three 15-pounder R. F. Guns.

1900. $15,100 allotted. No work done. **00,** 884.

1901. Materials purchased; work commenced; about 60% concrete laid; constr. work one-half done. **01,** 799.

1902. Parapets and earth embankments built; drainage system completed. **02,** 708.

Part 20, FSK. Miscellaneous.

Electric light and power plant—Left bank of Potomac R., Md. **1898.** $8,250 allotted. Work to be done by contract. **98,** 670.

1899. Plant installed and tested. Description of plant. Total cost of plant in place, $7,970.50. **99,** 827.

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Electric light and power plant—Right bank of Potomac R., Va. **1899.** $9,032.57 allotted. Work begun on power house and cistern; both completed except floor of power house. **99,** 833.

1900. House completed ready for engine and boiler. Plant not yet installed. **00,** 885.

1901. $4,800 allotted for plant with a 25-kilowatt generator. **01,** 799.

1902. Cistern and building for housing engine, boiler, and dynamo completed; aerial-pole line erected. **02,** 708.

—

Elevated rear passageways. **1901.** Left bank: $2,600 allotted for connecting gun platforms and observing station; constr. begun; work 30% completed. **01,** 796. Right bank: $1,485 allotted. Work 25% completed. **01,** 800.

1902. Left bank: Work completed. **02,** 706. Right bank: Work completed. **02,** 709.

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Mounting 10-inch gun on barbette—Left bank of Potomac R., Md. **1898.** $1,750 allotted for mounting for defense the 10-inch gun and carriage sent for experimental firing; platform was built in May and gun and carriage mounted. **98,** 671.

1899. Gun removed from its temporary position and mounted on its platform in readiness for firing at targets. **99,** 824.

—

Washington, D. C.—Obstructions of the Potomac R. **1866–69.** Several methods of preparing and estab. suitable obstructions under consideration. **66,** 13; **67,** 12; **68,** 15; **69,** 15.

1870–76. Not found practicable to make the desired experiments upon these obstructions; material stored at Fort Foote. **70,** 21; **71,** 17; **72,** 14; **73,** 15; **74,** 18; **75,** 19; **76,** 20.

1877. Building in which material was stored repaired. **77,** 16

1879–80. Repair of buildings. **79,** 23; **80,** 39.

—

Washington, D. C.—Telephone booths. **1898.** Batteries B and C, $160 allotted; work completed and the booths set in place. **98,** 670.

—

Experimental parapets and platform—Left bank of Potomac R., Md. **1898.** $20,250 allotted for building experimental parapets, shield, and platform, and parapet for gun. Work begun in December, nearly completed. **98,** 668.

1899. $1,500 allotted. Gun mounted and work completed. Parapets tested June 29, 1899. **99,** 826.

1900. Removing loose concrete so as to trace the path of the projectile, and minor repairs. **00,** 880.

1901. Gun and carriage shipped away; gun platform filled up and graded. **01,** 795.

Part 21, FSK. Preservation and Repair.

1898. Three buildings repaired for employees. **98,** 668. Repairs of mining casemates; strengthening the parapet in front of 15-inch guns; fitting up a field magazine for 15-inch gun. $175 allotted for dismounting and shipping two 15-inch guns and carriages. Minor repairs of wharf, cisterns, fences, etc. **98,** 669. $500 allotted for purchase of some equipage, painting concrete surface of emplacement, and clearing fronts of guns. **98,** 671. Wire fence 5' high built around 8-inch emplacement at cost of $340. **98,** 678.

1899. Left bank of Potomac R., Md.: $6,678 allotted. Roller paths of two 15-inch S. B. guns taken up and shipped; superior slope injured by firing, repaired; slopes, roadways, drainage, torpedo material, and ammunition lifts, etc., repaired. **99,** 830. $954 allotted for repairs of earth slopes and roadway of Battery G; minor repairs. **99,** 834. $550 allotted for emergency purposes. Right bank of Potomac R.: Cutting timber to afford a clear field of fire for the three 8-inch guns. Work completed. **99,** 834.

1900. $2,892 allotted for emplacements on left bank of R. Searchlight outfits cared for, quarters repaired, and minor work. **00,** 880. $1,354 allotted for emplacemets on right bank of R., repairs of slopes, drains; altering ammunition hoists and minor work. **00,** 885.

1901. $1,225 allotted for misc. repair work; magazines and corridors lined with tile, left bank Potomac R. **01,** 797. $725 allotted. Right bank; repairs to ammunition lift; drains cleaned, rubbish removed, etc. **01,** 801.

1902. Left bank: $310 allotted. Repairs made to ammunition lifts, parapet 10-inch battery, slopes; grass and weeds cut. **02,** 706. Right bank: Batteries cared for and cleaned up; misc. repair work done; $110 allotted. **02,** 709.

Part 22, FSK. Range and Position Finders.

1898. Batteries B and C—$350 allotted for 2 observing stations; work completed. **98,** 670.

1899. $93 allotted for mounting 2 type B range finders each at Batteries B, C, and D. Work completed in October, 1898. **99,** 830. $100 allotted for taking accurate horizontal measurements and making blue prints for location of range finders; work completed. **99,** 830. $3,692 allotted for battery-commander's station at Battery D. $222 allotted for 2 type B range finders at Battery G. Work begun. **99,** 830, 833.

1900. $20,720 allotted for battery-commander's station at 10-inch batteries; stations about three-fifths completed. **00,** 879. $4,259 allotted for battery-commander's station near the 8-inch battery; work about 60% finished. **00,** 885.

1901. Left bank: Battery-commander's station practically finished. **01,** 794. Right bank: Battery-commander's station practically finished. **01,** 800.

1902. Left bank: Stations turned over Aug. 29, 1901. **02,** 706. Right bank: Work on stations completed; turned over Aug. 26, 1901. **02,** 709.

Part 23, FSK. Sites.

Sheridans Point, below Washington, D. C. $13,576.87 paid for 90.6 acres by appraisement. **92,** 9; **93,** 11.

Part 24, FSK. Submarine Mines.

1891. One mining casemate being built. **91,** 7.

1893. Mining casemate completed; cost, $15,784.95. **93,** 8.

1898. Cable storage tanks completed. **98,** 667. $4,900 allotted for a brick storehouse for submarine mine material. Walls and roof completed. **98,** 668. Waterproofing mining casemate. **98,** 669. $3,500 allotted for purchase of explosives. $13,725 allotted for planting mines; casemates fitted up and machinery installed; 3 triangulation stations laid out and mines planted. **98,** 675. $925 allotted for observing tower and range-finding station; completed. **98,** 678.

1899. Cable-storage tank, small addition made to foundation at front of shed, and a gravel platform built in front of it; minor work. **99,** 827 Storehouse for submarine mine material; floor 1 foot thick built; storeroom for confidential and delicate apparatus built; racks for mine cases put up; sea wall built along R. front and building completed. **99,** 827. $4,500 allotted for extending the mining casemate; work begun and excavation nearly completed. **99,** 828. $9,746 allotted for torpedo defense; all mines and cables removed from R., cleaned, and stored; searchlight operated. Unloading mines described. **99,** 828.

1900. Extension to the mining casemate built in 1891 completed. **00,** 880.

Part 25, FSK. Supplies for Seacoast Defenses.

1900. $600 allotted Nothing done. **00,** 881.

1901. Supplies purchased and issued. **01,** 796.

1902. $355 allotted. Boiler electric plant put in order; supplies purchased and issued **02,** 706.

FSL. HAMPTON ROADS, VA., FORTIFICATIONS.

(NOTE.—Reports on these works from 1903 to 1912 are of a general character only. See the first 15 pages of each annual report from 1903 to 1912.)

Part.	Title.	Period.
1	Contracts	1887–1902
2	Engineering features	....
3	Engineers—Chief of Engineers	1866–1912
4	BE	1882–1888
5	In charge	1866–1902
6	Assistants	1891–1898
7	Forts, etc. (allotments, operations, etc.)	1817–1912
8	Fort Monroe, Old Point Comfort, Va	1817–1886
9	Fort Wool (Fort Calhoun)	1818–1901
10	Redoubt A—Emplacements, 10-inch guns	1892–1898
11	Emplacement, one 10-inch gun	1893–1898
12	Mortar battery, sixteen 12-inch mortars	1895–1902
13	Platform, 8-inch rifle on A. R. F. barbette carriage, model 1892	1898
14	Redoubt B (left half)—Emplacement, 10-inch gun on spit	1897–1901
15	Redoubt B–C—Three 10-inch gun emplacements	1898–1901
16	Four 4.72-inch R. F. gun emplacements	1898–1899
17	Platforms, four 8-inch rifles on parapet	1898–1899
18	Emplacement, 10-inch gun in bastion	1899–1902
19	Battery, three 12-inch guns	1899–1902
20	Emplacements, four 15-pounder R. F. guns	1900–1902
21	Emplacements, two 6-inch R. F. guns	1901–1902
22	Emplacements, two 12-inch guns	1901–1902
23	South side of chan.—Emplacements, two 6-inch R. F. guns	1902
24	Emplacements, four 3-inch R. F. guns	1902
25	Miscellaneous (electric plant; ammunition hoist; maneuvering installation; destruction of loaded mine; M. B. electric plant; M. B. azimuth circles; railings; speaking tubes; tide gauges; gallery; walks; bridge, Mill Creek, Va.; reinforcing magazines; sewerage system; wharf)	1899–1902
26	Preservation and repairs	1898–1902
27	Range and position finders	1897–1902
28	Sea walls and embankments	1891–1902
29	Sites	1892
30	Submarine mines	1891–1900
31	Supplies	1901–1902
32	Water supply	1868–1893

Part 1, FSL. Contracts.

1887. Wharf, $88,305. **88,** 806.

1889. Storehouse, $7,440. **90,** 386.

1897. Tower and wooden building for range finder, $1,179. **97,** 660.

1898. Electric-light plant, $4,420. **98,** 685.

1899. Concrete storage tank, $1,769.50. **99.** 840.

1900. American cement, 66⅔¢ per barrel; Portland cement, $2.30 per barrel; broken st., $1.389 per c. y.; granolithic st., $1.389 per c. y.; Rosendale cement, $1.05 per barrel. **00,** 888, 891.

1901. Material for battery-commander's station, $2,695. **01,** 805.

1902. Steel I beams, 2.7¢ per pound; connection plates, bolts, etc., 4¢ per pound; st. (broken), 1 and 2 inch, $1.58 per c. y.; Portland cement, $1.40 per barrel. **02,** 712. Yellow pine lumber, $600; broken st., $1.50 per c. y.; anchor bolts, I beams, etc., prices listed. **02,** 713. Steel and iron for fire-commander's and battery-commander's stations, $14,847. **02,** 715. Wharf, $7,450; yellow pine lumber, $593.80; anchor bolts, I beams, etc., prices listed; Portland cement, $1.51 per barrel; broken st., $1.50 per c. y. **02,** 720.

Part 2, FSL. Engineering Features.

Concrete mixing. **99,** 843.
Condensation, preventing. **05,** 3009.
Dampproofing. **04,** 3721. Hollow brick. **05,** 3009 (pl.).
Datum points. **04,** 3721 (pl.).
Flash plates. **99,** 835.
Materials, detailed cost of. **97,** 657, 658, 660; **98,** 684; **99,** 844; **00,** 888.
Mines, method of unloading. **99,** 842.
Range-finder tower, description of. **97,** 661.
Sewerage system, report on, with detailed cost **97,** 663.
Ventilating system, description of. **00,** 893.
Waterproofing. **98,** 679; **00,** 893.

Part 3, FSL. Engineers.

Chief of Engineers. **R., 66,** 13; **67,** 12; **68,** 15; **69,** 15; **70,** 22; **71,** 18; **72,** 15; **73,** 16; **74,** 19; **75,** 19; **76,** 21; **77,** 17; **78,** 20; **79,** 24; **80,** 40; **81,** 39; **82,** 36; **83,** 32; **84,** 37; **85,** 31; **86,** 30; **88,** 107; **89,** 12; **90,** 9, 385; **91,** 8, 10, 530; **92,** 8, 10, 465; **93,** 9, 635; **94,** 10, 14; **95,** 9, 508; **96,** 16, 492; **97,** 16, 657; **98,** 23, 679; **99,** 25, 834; **00,** 23, 886; **03,** 9; **04,** 5, 9, 10; **05,** 5; **06,** 5; **07,** 5; **08,** 9; **09,** 10; **10,** 12, **11,** 8; **12,** 7.

Part 4, FSL. Board of Engineers.

Constituted, 1882, to consider and report upon the condition of fortifications, and what number, if any, could be dispensed with. **R., 82,** 421.

Constituted, 1886, by S. O. No. 268, Nov. 17, 1886, to select and report upon site and plan for wharf. **R.,** 88, 805. (Col. Tidball and Lt. Cols. Chandler and Hains.)

Part 5, FSL. Engineers in Charge.

Col. H. Brewerton, 1866–70.
Maj. W. P. Craighill, 1870–75.
Col. Q. A. Gillmore, 1875–86.
Capt. J. C. Post, 1883.
Lt. Col. P. C. Hains, 1887–92. **R., 88,** 804; **89,** 468; **90,** 385; **91,** 529.
Maj. L. C. Overman, 1892.
Capt. T. Turtle, 1892.
Maj. C. E. L. B. Davis, 1892–96.
Maj. T. L. Casey, 1896.
Maj. J. B. Quinn, 1900–02.
Col. Peter C. Hains, 1902.

Part 6, FSL. Assistants.

Lt. G. A. Zinn, 1891–94.
Lt. D. DuB. Gaillard, 1895; (Capt.) 1896.
Lt. C. A. F. Flagler, 1896.
Lt. C. W. Kutz, 1896–97.
Lt. F. A. Wilcox, 1898–99.
Lt. E. H. Schultz, 1898.

Part 7, FSL. FORTS AND BATTERIES.

Part 8, FSL. Fort Monroe, Old Point Comfort, Va.

1817. Work begun. **80,** 40.

1866. Reinforcement of gun platforms; regrading ramp surfaces; alterations made to adapt water battery to the new 10-inch gun armament; several front pintle platforms for 15-inch guns built in the covered way; and minor work. **66,** 13.

1867. Relaying platforms; brs., st. pavements, and slopes, etc., repaired; repairing embrasures, removing traverse circles, and constr. 18 projectile platforms of water battery. **67,** 12.

1868. Repairs to floors and embrasures of casemates, terreplein, slopes, and ramp, and grading roadway; repairs to roofs of casemates in water battery and covered way, and minor repairs; 400′ of wooden breast-height repaired or rebuilt in the redoubt; a st. wall 80′ long built to support foot of glacis, and repairs to slopes. **68,** 16.

1869. Center pintle platforms for 15-inch guns built in front 4 and parapet increased in thickness; front pintle platform for 15-inch gun built in covered way; grading 1,000 l. f. of roadway; work on drains, cleaning scarp walls, and repairing terreplein slope and ramps. Water battery—repairs to roofs of casemates, rebuilding part of sustaining wall in rear of 2 platforms, and minor repairs. **69,** 15.

1870. Modification plan prepared. General repairs to pavements, cisterns, terrepleins, ramps, roadway, and break'r. **70,** 22.

1871. General repairs. Summary of work. **71,** 18.

1872. $42,500 app. Repairing and rebuilding three 15-inch gun platforms; replacing pintle stones injured by experimental firing of 1871; rebuilding 2 front pintle 15-inch gun platforms in covered way and minor work. **72,** 15.

1873. $40,000 app. Six shot furnaces removed. Two casemates floored and plastered for officers' use. Two cisterns built; repairs to break'r, ramps, terreplein, casemate, etc. Work begun on modification plans; 6,000 c. y. sand placed. BE. est. it would cost $250,000 for permanent barracks. **73,** 16.

1874. $30,000 app. Masonry of magazine and foundations of 2 gun platforms completed; work on masonry of traverse magazine, and sand placing in the redoubt. Summary of work. Proj. for battery of 10 guns of heaviest caliber, exterior to fronts 2 and 3, and for a battery of 2 guns on fronts 1, 2, 3, and 4 of main work. **74,** 19.

1875. $20,000 app. Platforms Nos. 5 and 6, and 2 service magazines completed; parapet raised and graded; piers of postern br. repaired and entire superstr. of br. rebuilt; repair of wooden break'r. **75,** 19.

1876. Platforms and breast-height walls in advanced redoubt nearly completed. Work on terrepleins and slopes and roadways. Three platforms for heavy guns and 15 for lighter ones ready for armament. **76,** 21.

1877. Break'r repaired. Preservation and repair. Armament—10-inch Rodman guns dismounted from platforms 87, 88, 89, and 93; 100-pounder Parrott rifles dismounted from platforms 91, 92, and 94, and mounted on platforms 87, 88, and 89. Eight-inch converted rifle guns mounted on platforms 91, 92, 93, and 94. **77,** 17.

1878. Repair of brs. and break'r. Timber 13-inch sea-coast mortar platform laid, fronts 4 and 5. **78,** 20.

1879. Boathouses and brs. repaired. **79,** 24.

1880. Description of fort. Repair of parapet, slopes, etc. **80,** 40.

1881–84. General repairs. Summary of work. **81,** 40; **82,** 37; **83,** 32; **84,** 39.

1885. Breast-height wall and parapet on fronts 4 and 5 repaired and completed; replacing 5-inch pintles with 6-inch pintles. Permanent platforms for 10-inch Rodman guns Nos. 51 and 52 on barbette of main work completed. Minor work. Summary of work. **85,** 31.

1886. Platform 96 put in serviceable order; numerous repairs. Summary of work. **86,** 30.

Part 9, FSL. Fort Wool, Formerly Fort Calhoun.

1818. Work begun. **80,** 41.

1858. Work resumed. **80,** 41.

1866. Work on the masonry of the scarp and piers. Summary of work. **66,** 14.

1867. Preparations for building the magazine of the first tier at the capital at the e. and w. ends. Summary of work. **67,** 12.

1868–69. Work on constr. of magazines of first tier. Summary of work. **68,** 16; **69,** 16.

1870. Projs. for completion being prepared. Work on magazine of first tier and superstr. of magazine at w. end; stairway and passage finished; minor work. Casemates 2 to 53, inclusive, of first tier ready for guns. **70,** 22.

1871–78. Operations suspended August, 1870. Preservation and care. **71,** 19; **72,** 15; **73,** 17; **74,** 20; **75,** 20; **76,** 21; **77,** 17; **78,** 20.

1879. Repair of wharf and fort-keeper's quarters. BE. prepared modification plans for heaviest armament. **79,** 24.

1880–86. Description and importance of fort. Preservation and repair. **80,** 41; **81,** 41; **82,** 38; **83,** 34; **84,** 40; **85,** 32; **86,** 32.

1898. $425 allotted, 1897. Preservation and care. **98,** 688.

1899. $1,200 allotted. Preservation and care **99,** 841.

1901. $300 allotted for care and preservation. **01,** 812.

Part 10, FSL. Redoubt A—Emplacements for 10-inch Guns.

1892. $158,848 allotted, 1891. Work begun placing concrete. **92,** 8.

1893. Concrete for parapet in place and half of earthwork on the front completed. **93,** 9.

1894. Emplacements for 2 guns completed; awaiting carriages. **94,** 10; **95,** 9.

1896. $3,744 received from other works for completing the emplacements. $10,292 allotted for constr. 2 platforms; were completed. Summary of work. **96,** 492.

1897. $1,300 allotted. Guns and carriages received; mounted by the garrison. Summary and detailed cost of work. Total cost, $154,379.99. **97,** 656.

1898. $1.605 allotted. Waterproofing magazines, planting hedge in rear of battery, and installing electric-light plant. **98,** 679.

Part 11, FSL. Redoubt A—Emplacement for One 10-inch Gun.

1893. $64,000 allotted in 1892. Work begun. **93,** 9.

1894. Emplacement completed; awaiting carriage. **94,** 10.

1896. $9,774 transferred to other works. $5,020 allotted for constr. platform; practically completed. Summary of work. **96,** 493.

1897. Carriage and gun received, mounted, and turned over to the commanding officer. Work completed. Summary and detailed cost of work. Total cost, $59,246. **97,** 658.

1898. $552.50 allotted. Waterproofing magazine and installing a small chloride electric storage battery. **98,** 680.

Part 12, FSL. Redoubt A—Mortar Battery, Sixteen 12-inch Mortars.

1895. $100,000 allotted. Work begun on repair of wharf. **95,** 9.

1896. Plans modified, repair of wharf completed, and plant constr. **96,** 494.

1897. $100,000 allotted. All concrete in the pits, wing walls, and main work, and 20,200 c. y. sand placed. Summary and detailed cost of work. **97,** 659.

1898. Mortars mounted. Work completed; 21,741 c. y. concrete placed. Detailed cost of work. Mortars fired. **98,** 683.

1899. Because of dampness in main magazine, 2 small temporary magazines built at cost of $1,299.60. Description. **99,** 839.

1900. $1,246 allotted. Waterproofing. Ventilating system, description of. Concrete steps placed up the slope of center traverse. **00,** 893.

1901. $1,000 allotted for removing switches, st. bins, cement houses, and other plant; work done. **01,** 808.

1902. Taking down 4′ cubical concrete mixer; storing machinery; taking up and relaying RR. track. **02,** 714. $3,400 allotted for renewing interior wiring; no work done. **02,** 717.

Part 13, FSL. Redoubt A—Platform for 8-inch Rifle on A. R. F. Barbette Carriage, Model 1892.

1898. $1,800 allotted. Rifle, mounted for some time on a platform at n. end of water battery for target practice, transferred to a platform behind the cover of the mining casemate. 210 c. y. of concrete placed in platform. Work completed; cost, $1,608.08. **98,** 686.

Part 14, FSL. Redoubt B (Left Half)—Emplacement for 10-inch Gun on Spit.

1897. Plans being made for 10-inch gun mounted on an experimental disappearing carriage, model 1894. **97,** 659.

1898. $50,000 allotted. Work begun and 2,623 c. y. of concrete and 12,038 c. y. sand cover placed. **98,** 680.

1899. Battery nearly completed; gun and carriage received, but not mounted. Summary of work. **99,** 835.

1900. Gun mounted by garrison and tested; electric plant partly installed and minor work. **00,** 886.

1901. System of wiring completed; emplacement turned over Jan. 3, 1901. **01,** 802.

Part 15, FSL. Redoubt B–C (Right Half)—Three 10-inch Gun Emplacements.

1898. $125,000 allotted. Work begun. Redoubt C, 3,725 c. y. concrete and 2,186 c. y. sand placed. Right half of redoubt B, 1,067 c. y. concrete and 10,390 c. y. sand placed. **98**, 689.

1899. $5,000 allotted for completion; 3 emplacements practically completed; armament in place. Summary and cost of work. **99**, 836, 843.

1900. Slope completed; setting up storage battery. **00**, 889.

1901. Electric light installed. **01**, 802.

Part 16, FSL. Four 4.72-inch R. F. Gun Emplacements.

1898. $18,000 allotted. Plans modified. Work begun on platforms on barbette tier. Five old platforms removed; 3 new platforms completed. **98**, 690.

1899. All guns mounted and a magazine to serve them built in the interior slope of main work; cost of platform and magazine, $2,777.01. **99**, 845.

Part 17, FSL. Platforms for Four 8-inch Rifles on Parapet.

1898. $8,000 allotted. Work begun on temporary platform and completed and guns mounted. Five old platforms and material removed. **98**, 690.

1899. Two carriages and guns removed from platforms and shipped to other points. **99**, 845.

Part 18, FSL. Emplacement for 10-inch Gun in Bastion.

1899. $38,000 allotted. Work begun dismounting 3 old guns. 3,058 c. y. concrete placed. **99**, 836.

1900. Work nearly completed. Gun and carriage received and part of carriage assembled. Detailed cost of work. **00**, 888.

1901. Work of minor importance done; railing set, walls and rooms whitewashed, painting, etc.; walk laid. **01**, 802.

1902. Iron hoods placed over doors; ammunition hoists cleaned; building 2 platforms. **02**, 710.

Part 19, FSL. Battery for Three 12-inch Guns.

1899. $150,000 allotted. Work begun. 8,500 c. y. sand placed for filling; 8,834 c. y. concrete placed. **99**, 837.

1900. Battery, except minor work, completed; awaiting completion of assembling 4 carriages. Summary of work. **00**, 889.

1901. Electric wiring finished; cable lines laid; painting and whitewashing; 2 carriages and guns mounted. **01**, 803.

1902. System of speaking tubes put in. **02**, 711.

Part 20, FSL. Emplacements for Four 15-pounder R. F. Guns.

1900. $12,500 allotted. Work begun placing 1,349 c. y. of sand for filling. Battery practically completed. **00**, 890.

1901. Slopes completed; work delayed awaiting armament. **01**, 804.

1902. Minor work of mainten. **02**, 714.

Part 21, FSL. Emplacements for Two 6-inch R. F. Guns.

1901. $30,000 allotted. Plans and ests. under way. **01**, 804.

1902. A fill made; wall 2′ high built. **02**, 713.

Part 22, FSL. Emplacements for Two 12-inch Guns.

1901. $188,500 allotted. Site graded; laying out battery; 179 l. f. piling driven; 263 c. y. sand removed; track laid; proposals for work and material invited. **01,** 808.

1902. Driving of piles; constr. plant installed. misc. excavation work; details given. **02,** 712.

Part 23, FSL. South Side of Channel—Emplacements for Two 6-inch R. F. Guns.

1902. $34.000 allotted for preparation of plans etc. **02,** 719.

Part 24, FSL. South Side of Channel—Emplacements for Four 3-inch R. F. Guns.

1902. $40,000 allotted. Wharf built; assembling of plant, etc. **02,** 719.

Part 25, FSL. Miscellaneous.

Electric plant. **1899.** $960 allotted for supplies for operating. Plants in operation 6 months ending Jan. 1. 1899. Description of plant. **99,** 842.

1901. $10,160 allotted for increasing capacity sufficient to furnish current for lighting 1 of the 10-inch batteries, and a building for said plant; foundation of building completed. **01,** 807.

1902. Building completed. Generating set to be installed. **02,** 716.

Installation of ammunition hoist. **1902.** $2,275 allotted. No work done. **02,** 717.

Electric installation for maneuvering 12-inch armament. **1902.** $3,000 allotted. Small building erected; plant completed, except moving and setting up storage battery. **02,** 717.

Destruction of mine at Picketts H. **1901.** $25 allotted for destruction of loaded mine case. **01,** 810.

Building for mortar battery electric plant. **1901.** $2,900 allotted for changing location of storage battery on account of damp condition of rooms; new building erected, ready for placing doors and windows. **01,** 808.

1902. Slopes completed; doors and window frames set; storage battery taken down, etc. **02,** 714.

New azimuth circles at mortar battery. **1901.** $400 allotted. Old circles removed; platforms made ready for new ones. **01,** 807.

1902. $700 allotted. Azimuth circles for 2 carriages placed. **02,** 714.

Handrails. **1901.** $100 allotted. Handrails for loading platforms placed. **01,** 806.

Speaking tubes. **1901.** $505 allotted for speaking tubes at various batteries. **01,** 806.

Tide gauge. **1901.** $30 allotted for erecting tide gauge of float type; shelter for same constr. **01,** 806.

Gallery. **1901.** $165 allotted. Emplacement platforms connected; placing of handrails for loading platforms. **01,** 805.

Redoubt A, concrete walk. **1900.** $626 allotted for constr. concrete walk; also concrete covering leading to each of the platforms of the battery; no work done. **00,** 895.

1901. Walk laid 4′ x 376′; cost, $503.81. **01,** 805.

Iron pile br. over Mill Creek, Fort Monroe, Va. **1889.** $20,000 app. for br. between the military reservation of Fort Monroe and Elizabeth City County, Va. Description of proposed br. **89,** 12, 466.

1890. Work begun under contract and practically completed in May. Contract price, $17,500. **90,** 387.

Reinforcing water battery magazines. **1898.** $300 allotted. 263 c. y. sand placed in retaining wall and cribs built. **98,** 691.

1899. 320 c. y. earth placed as cover for magazines. **99,** 845.

Sewerage system, Fort Monroe. **1891.** $26,000 app., 1889. **91,** 10, 531.

1892. Sec. of War decided that two systems be constr., one by the U. S. and the other by residents of the reservation. **92,** 465.

1893. Discussion as to the best method of drainage. **93,** 14, 642.

1895. $37,500 app., 1894, for one-half of constr., the cost of the other half to be paid by the nonmilitary residents. Work begun; contract, $34,482.50. 4,391′ of 6-inch and 8-inch sewer pipe laid. Fifteen manhooes and about 10 c. y. of concrete and brick masonry placed. **95,** 9, 511.

1896. Sewerage system completed. Summary of work. **96,** 498.

1897. Post quartermaster at Fort Monroe assumed charge of operation and mainten. Total cost, $49,527.31. Report of receipt and expend. of constr. and mainten. **97,** 663.

Wharf at Fort Monroe. **1889.** $175,000 app. Work begun under contract in August, 1888. Plans modified for steel piles instead of wooden ones; nearly all the piles placed and half the flooring laid. Summary of work. **89,** 12, 464.

1890. Wharf completed in September, 1889, and custody transferred to the Quartermaster's Department, Dec. 4, 1889. Cost of materials. Storehouse on wharf nearly completed under contract, $7,439.67. **90,** 386.

1891. Constr. of pile jetty in progress. **91,** 530.

Part 26, FSL. Preservation and Repair.

1898. $3,500 allotted. Repairs of brs., walks, and quarters. **98,** 688.

1899. $3,266.45 allotted for general repairs. **99,** 840.

1900. $1,936.59 allotted for repair of brs., torpedo material, and minor work. Summary of repairs. **00,** 896.

1901. $1,175 allotted. Repairs, painting, whitewashing; renewing decayed timber. $1,000 allotted. Cleaning and painting torpedo material. $1,725 allotted. Base rings of carriages of mortar batteries releveled. **01,** 810. $100 allotted. Repairs to blocks and hoists of the ammunition service. $405 allotted for correcting faulty drainage; $775 allotted for repairing parapet and slopes; $1,255 allotted to determine cause of leakage of water; $1,100 allotted for preservation and repair. **01,** 811.

1902. $1,800 allotted for misc. repair work and payment of electrician's salary; drains cleaned; shelves and lockers provided or storage-battery room. **02,** 718.

Part 27, FSL. Range and Position Finder Stations.

1897. $1,800 allotted for tower and shelter. Work begun and completed under contract; turned over to the commanding officer. Description of work. **97,** 661.

1898. $500 allotted for 2 observation stations; both completed and instruments installed. **98,** 686.

1900. $100 allotted to enable data to be furnished the Board on Location of Position Finders as to elevations, etc., of sites selected for the constr. of completed range towers. **00,** 894. Plans for battery-commander's station near mortar battery being prepared. **00,** 895.

1901. $6,000 allotted for constr. battery-commander's station; entirely finished, ready for troops. **01,** 804, 805.

1902. Transferred to Artillery Oct. 17, 1901. **02,** 715.

1901. $172 allotted for 13 stations for emergency range finders provided for the several modern batterries. **01,** 806.

1902. $6,161.94 allotted for const. fire-commander's station; site graded. **02,** 715. $31,227.13 allotted for 5 battery-commanders' stations; foundation work. **02,** 716.

Part 28, FSL. Sea Walls and Embankments—Fort Monroe.

1891. $27,000 app. for beach protection. Work begun under contract on pile jetties. **91,** 10, 530.

1892. Four jetties built and work on sea wall. Summary of work. Work suspended. **92,** 466.

1895. $9,100 allotted for sea wall near old pile break'r; 272 l. f. of sea wall built. Work described. **95,** 508.

1896. Break'r completed; cost, $6,967.43. Summary of work. **96,** 495.

1900. $12,000 to be provided for constr. about 900′ of wall. **00,** 895.

1901. $23,000 allotted for concrete sea wall from engineer wharf to first jetty; work started at jetty 1; 175′ built; retarded by storms. **01,** 809.

1902. 333 l. f. concrete wall constr. during year and 3,450 c. y. sand placed. **02,** 717.

Part 29, FSL. Sites—Willoughby Point, Va.

Tract of 47 acres and 2 rights of way purchased for $23,500. **92, 10.**

Part 30, FSL. Submarine Mines.

1891. Concrete work of mining casemate completed; sand cover being placed. **91, 8.**

1892. Casemate completed; cost, $29,452. **92,** 8; **93,** 9.

1898. $21,150 allotted, 1897. Second casemate begun in 1897; casemate and gallery completed. Summary of work. **98,** 686. Cable storage tank built; cost, $2,072.79. **98,** 687. $27,000 allotted for torpedo defense; mines planted and cared for. Electrical firing apparatus set up in casemate. **98,** 692.

1899. $116.85 expended for fitting up an unused casemate of the main work for storing torpedo material and providing racks for 200 torpedoes, compound plugs, anchors, etc. **99,** 839. $2,000 allotted for extending cable tank; work completed; cost, $1,962.15. **99,** 840. $18,000 allotted for removing mines; most of them removed by exploding them on the surface of water. Material cleaned and stored. **99,** 841.

1900. $1,000 allotted for supplies for seacoast defenses. **00,** 895.

Part 31, FSL. Supplies for Seacoast Defenses.

1901. $1,500 allotted. Supplies purchased and issued. **01,** 809.

1902. $1,000 allotted. Supplies purchased and issued. **02,** 718.

Part 32, FSL. Water Supply.

1868. Artesian well begun in 1864–65 with a 12-inch pipe. 186′ of 5-inch pipe and 120′ of 8-inch pipe withdrawn from well of 1845, the 8-inch pipe to be driven inside the 12-inch pipe of the new well. Well 370′ deep. **68,** 16.

1869. Work continued on sinking the 8-inch pipe till the lowest section separated from the rest, at depth of 517′, then tubes 4½ inches diameter, with screw ends, inserted in the 8-inch pipe and driven to depth of 570′, where a limited amount of saline water was found. **69,** 15.

1870. Work continued on sinking the 4½-inch tubing. Total depth, 900′. **70,** 22.

1871. Well driven to depth of 906½′ below level of parade at Fort Monroe. Work suspended in August, 1870. Plant cared for. **71,** 18.

1872. Work resumed October, 1871, by drilling instead of boring. **72,** 15.

1873. Little progress made. Work suspended. **73,** 16.

1891. $6,000 app. for new well. Ests. of $4,000 more required before beginning work. **91,** 10, 530.

1892. Description of previous work. **92,** 467.

1893. Description of previous work and wells in other localities. **93,** 13, 685.

FSM. NORTH CAROLINA FORTIFICATIONS.

(NOTE.—Reports on these works from 1903 to 1912 are of a general character only. See the first 15 pages of each annual report from 1903 to 1912.)

Part.	Title.	Period.
1	Contracts	1897-1901
2	Engineering features	
3	Engineers—Chief of Engineers	1866-1912
4	BE	1882
5	In charge	1870-1902
6	Assistants	1895-1900
7	Forts, etc. (allotments, operations, etc.)	1826-1912
8	Beaufort, Fort Macon	1826-1886
9	Defenses at entrance	1898-1902
10	Cape Fear R.—Fort Caswell	1826-1886
11	New work at Old Brunswick	1872
12	Mouth—Emplacements, four 8-inch guns	1897-1901
13	Southport (Fort Johnson)	1898-1902
14	Mortar battery—Eight 12-inch steel mortars	1899-1902
15	Two emplacements, 12-inch B. L. rifles, nondisappearing carriages.	1898-1900
16	Two emplacements (one 4.72-inch R. F. gun, one 5-inch R. F. gun)	1898-1900
17	Emplacements for two 5-inch R. F. guns	1899-1902
18	Emplacements, two 15-pounder R. F. guns and one 5-inch gun	1901-1902
19	Miscellaneous (electric plant)	1899-1902
20	Preservation and repairs	1899-1902
21	Range and position finders	1901-1902
22	Sea walls and embankments	1900-1902
23	Submarine mines	1895-1899
24	Supplies	1902

Part 1, FSM. Contracts.

1897. Emplacements for three 8-inch guns, $86,631.45 for 2; itemized cost. **97**, 671.

1899. Mixing and placing concrete, $1.20 per c. y. **99**, 856.

1900. 6,000 t. broken st., $1.73 t.; 7,000 t. large st., $1.53 t. **01**, 813. Unloading and transporting st. from cars, 41¢ and 40¢; 500,000 c. y. material for, filling, 13.7¢ c. y.; erection of steel observation, tower, $3,400. **01**, 814.

Part 2, FSM. Engineering Features.

Cable tank, description and cost. **99**, 858.

Carriages, releveling. **00**, 904.

Concrete forms. **99**, 851.

Concrete, wet and dry. **00**, 906.

Cracks caused by settlement of battery, method of repairing. **99**, 859.

Doors. **01**, 922.

Drainage system. **00**, 910.

Electric plant, description and cost. **99**, 849.

Grass; Bermuda grass satisfactory. **02**, 2465.

Guns, moving and mounting, and cost. **99**, 853.

Leakage, prevention of. **00**, 898, 908; stopped by linseed oil. **02**, 2465.

Masonry, composition of. **99**, 852.

Materials, quantity and cost of. **97**, 674; **98**, 696; **99**, 852, 856; **00**, 906.

Percolation, oil treatment. **03**, 2408.

Piles, pile driving with derrick. **01**, 922.

Plant, description and cost. **97**, 673; **99**, 851, 852, 856; **00**, 908.

Settlement, avoiding unequal settlement. **01**, 922.

Shores, protection of. **05**, 3010. Jetties. **05**, 3010 (pl.).

Storehouse, torepdo, description and cost. **99** 858.

Telephones, boxes for. **01**, 922.

Walls, linings. **01**, 922.

Walls, sea. Details. **01**, 921 (pl.). Repairs. **05**, 3010.

Waterproofing. **00**, 898.

Part 3, FSM. Engineers.

Chief of Engineers. **R., 66,** 14; **69,** 16; **70,** 22; **71,** 19; **72,** 15; **73,** 17; **74,** 20; **75,** 20; **76,** 21; **77,** 17; **78,** 21; **79,** 25; **80,** 41; **81,** 41; **82,** 38; **83,** 35; **84,** 40; **85,** 33; **86,** 33; **95,** 10; **96,** 17, 501; **97,** 16, 670; **98,** 24, 692; **99,** 25, 845; **00,** 23, 897; **01,** 6, 24; **02,** 7, 24; **03,** 9; **04,** 5; **05,** 5; **06,** 5; **07,** 5; **08,** 9; **09,** 10; **10,** 12; **11,** 8; **12,** 7.

Part 4, FSM. Board of Engineers.

Constituted, 1882, to consider and report upon the condition of fortifications, and what number, if any, could be dispensed with. **R., 82, 422.**

Part 5, FSM. Engineers in Charge.

Col. Q. A. Gillmore, 1870–86.
Capt. J. Mercur, 1883–84.
Capt. J. C. Post, 1883.
Capt. F. A. Hinman, 1884–85.
Capt. W. H. Bixby, 1885–86.
Maj. W. S. Stanton, 1895–96.
Lt. Col. D. P. Heap, 1896–97.
Capt. W. E. Craighill, 1897–99.
Capt. E. W. Van C. Lucas, 1899–1902.

Part 6, FSM. Assistants.

Lt. E. W. Van C. Lucas, 1895.
Lt. E. Jadwin, 1896–98.
Lt. J. C. Oaks, 1898–99. **R., 98, 695.**
Lt. E. I. Brown, 1899–1900.

Part 7, FSM—

FORTS AND BATTERIES.

Part 8, FSM. Fort Macon, Beaufort Harbor.

1826. Work begun. **80,** 41.

1866. Question of modifications to be placed before the BE. **66,** 14.

1870. Modification plans under consideration. **70,** 22.

1871. Timber wharf, and jetty to protect same, built; cost, $4,779. **71,** 19.

1872–73. Work on wharf and break'r under wharf. **72,** 16; **73,** 17.

1874. Jetty and cribwork built w. of wharf. **74,** 20.

1875. Timber cribwork and break'r completed (severe storm destroyed part of these works). **75,** 20.

1876–78. Subject of modification still under consideration. **76,** 21; **77,** 17; **78,** 21.

1879. Br. across ditch repaired and new wooden covers placed over the ventilation of all casemates. **79,** 25.

1880–82. Board sand-catch built to restore the beach to its former area and height. Results satisfactory. **80,** 41; **81,** 41; **82,** 38.

1883. Parapet and glacis cleared, and fence and jetties repaired. **83,** 35.

1884. Work continued on jetties. **84,** 40.

1885–86. Care and preservation. Summary of repairs. **85,** 34; **86,** 33.

Part 9, FSM. Beaufort Harbor—Defense at Entrance.

1898. $3,000 allotted. Carriages of two 100-pounder Parrott rifles put in good order and 1 of the guns moved to a new and more advantageous position. Two 10-inch S. B. mortars mounted on covered way and a magazine arranged for them. Two platforms for the same mortars were also arranged on the parade. Splinter-proof traverses built for the protection of guns and mortars. 98, 692.

1899. Minor work done to complete the placing of the 100-pounder Parrott rifles and two 10-inch S. B. mortars. 99, 846.

1902. Two 12-pounder guns dismounted and shipped. 02, 72P.

Part 10, FSM. Fort Caswell, Cape Fear River.

1826. Work begun. 80, 42.

1866. Question of modification to be placed before BE. 66, 41.

1870–86. Importance of fort. Modification plans under consideration. 70, 22; 71, 19; 72, 16; 73, 17; 74, 20; 75, 21; 76, 22; 77, 18; 78, 21; 79, 26; 80, 42; 81, 42; 82, 30; 83, 35; 84, 41; 85, 34; 86, 34.

Part 11, FSM. New Work at Old Brunswick, Cape Fear River.

1872. Plans and ests. being prepared. 72, 16.

Part 12, FSM. Mouth of Cape Fear River—Emplacements for Four 8-inch Guns.

1897. $127,900 allotted. Work begun under contract for 3 emplacements. 2,966 c. y. concrete and 2,286 c. y. sand for embankment placed. Work given in detail with cost. 97, 670, 672.

1898. $43,000 allotted. Three emplacements completed and guns and carriages mounted. Work begun on fourth emplacement March 18 completed, and gun and carriage mounted by May 12. Battery completed, except railings, trolleys, etc. 98, 693.

1899. $2,000 allotted for installing storage battery. Battery completed. Repairs of electric wiring, drainage system, and filling of cracks caused by unequal settlement of battery with asphalt dissolved in naphtha; cistern cleaned and trees planted; traverse circle of gun No. 4 releveled. 99, 847, 858.

1900. Releveling carriages; new drainage system laid and slopes from terreplein to floors repaired by removing the turfing and covering the slopes with a layer of concrete 4 inches thick. 00, 904.

1901. $700 allotted for communicating gallery. 01, 815.

Part 13, FSM. Reservation at Southport (Fort Johnson).

1898. Repair of building on reservation. Proceedings instituted for possession of the reservation by parties claiming to have acquired rights to the property. 98, 693.

1899. Suits for possession of reservation still pending. 99, 846; 00, 897.

1901. Suit still pending. 01, 813.

1902. Suit settled by payment from app. for imp. Cape Fear R. 02, 720.

Part 14, FSM. Mortar Battery for Eight 12-inch Steel Mortars.

1899. $112,000 allotted. Work begun in August, 1898; masonry completed; floors laid; trolleys placed; 29,000 c. y. sand placed in parapet, and 1,801 sq. y. sod placed; 4 mortar pits finished; 7 carriages and 8 mortars received; $2,120 allotted for mounting; in progress. Itemized cost of work. **99,** 847, 848, 854, 856.

1900. All guns mounted and battery completed, except installing electric-firing apparatus; constr. work, with cost, in detail; description of wet and dry concrete; foundations for mortars; cracks, methods of filling; plant and materials; drainage system; electric lighting, and damage done by storm of Oct. 30, 1899. **00,** 905–910.

1901. $1,400 allotted. **01,** 815.

1902. Work of releveling taken up. **02,** 721.

Part 15, FSM. Two Emplacements for 12-inch B. L. Rifles on Non-disappearing Carriages.

1898. $90,000 allotted. Work begun on platforms May 11 and completed May 27; excavation completed and 4,070 c. y. concrete placed; wharf strengthened for unloading guns. **98,** 693, 696, 697.

1899. $38,325 allotted. Guns and carriages mounted and battery completed. Description and detailed cost of work. **99,** 846, 848, 852, 854.

1900. Repair of drains. **00,** 905.

Part 16, FSM. Two Emplacements—One for 4.72-inch R. F. Gun and One for 5-inch R. F. Gun.

1898. $3,000 allotted for mounting guns. The 5-inch emplacement incorporated in the fourth emplacement for 8-inch B. L. rifle and completed when that emplacement was finished. The 4.72-inch R. F. emplacement was built on parapet of the old fort; work completed; no guns received. **98,** 694, 696.

1899. $3,000 allotted. Guns mounted and all work completed; turned over to the garrison. **99,** 26, 847, 854.

1900. $600 allotted for installing ammunition lift in 4.72-inch emplacement; lift purchased and installed; description and tracing. **00,** 897, 898, 899, 905.

Part 17, FSM. Emplacements for Two 5-inch R. F. Guns.

1899. $10,500 allotted. Work begun in 1898 on 1 emplacement. Concrete placed by contract. Wagon road built to connect with mortar battery; masonry and all other work completed; awaiting arrival of carriage. Itemized cost of the emplacements. **99,** 847, 856.

1900. Parapet restored at cost of $425. No armament as yet. **00,** 897, 911.

1901. One gun provided with a carriage. **01,** 813.

1902. Transferred to garrison. **02,** 721.

Part 18, FSM. Emplacements for Two 15-pounder R. F. and One 5-inch Gun.

1901. $20,000 allotted. Plans approv.; work in progress on 15-pounder. **01,** 813.

1902. $1,700 allotted. Emplacements finished. **02,** 721.

Part 19, FSM. Miscellaneous—Electric Plant.

1899. Located in casemate of old fort. Description of plant, with tabulated statement of cost of installation. **99,** 849.

1902. $3,000 allotted for rewiring batteries. **02,** 722.

Part 20, FSM. Preservation and Repair of Fortifications.

1899. General repair of 8-inch emplacement. **99,** 858.

1900. $2,225 allotted. Releveling 8-inch gun carriages and repair of drainage of 8-inch and 12-inch emplacements. **00,** 904.

1901. $2,070 allotted. Carriages at emplacements 1, 2, and 3 of battery for four 8-inch rifles releveled; safety stops provided for electric ammunition hoists; submarine mining equipment cared for; other misc. repair work. **01,** 813.

1902. Repairs to drainage service, pavements, parapets, ammunition lifts, etc. **02,** 721.

Part 21, FSM. Range and Position Finders.

1901. Work on fire-commander's station started; foundation well advanced; $8,800 allotted. **01,** 813.

1902. Completed and transferred to garrison. **02,** 721.

Part 22, FSM. Sea Wall and Embankment—Fort Caswell, N. C.

$150,000 app. May 25, 1900. Violent storm occurred Oct. 30 and 31, 1899. Report submitted by Capt. Lucas, describing the storm and damages caused by it, with plans and ests. of cost and repairs. Proj. submitted. **00,** 900.

1901. Concrete wall 6,612′ long built. **01,** 813.

1902. Low places filled to 12′ above m. l. w. Work in progress restoring wagon roads and RRs. **02,** 721.

Part 23, FSM. Submarine Mines.

1895. $7,600 allotted, 1894, for mining casemate and cable gallery; work begun. **95,** 10.

1896. $2,000 allotted. Both completed. Total cost, $8,361.98; detailed cost of work. **96,** 17, 501.

1898. $10,600 allotted. Torpedo casemate fitted up with operating apparatus; torpedoes planted. Telephone and telegraph connections made with Wilmington, N. C., and minor work. **98,** 695, 697.

1899. $2,900 allotted for removing mines, caring for same, and alterating mining casemate; mines removed, cleaned, and stored. **99,** 848. $1,250 allotted for cable tank, which was completed; cable stored; description; itemized cost. **99,** 848, 857. $6,500 allotted for torpedo storehouse; completed, fireproof, and lighted by electricity; description and itemized cost. **99,** 849, 858.

Part 24, FSM. Supplies for Seacoast Defenses.

1902. Supplies issued. **02,** 721.

FSN. SOUTH CAROLINA FORTIFICATIONS.

(NOTE.—Reports on these works from 1903 to 1912 are of a general character only. See the first 15 pages of each annual report from 1903 to 1912.)

Part.	Title.	Period.
1	Contracts	1896–1899
2	Engineering features	
3	Engineers—Chief of Engineers	1866–1912
4	BE	1882
5	In charge	1870–1902
6	Assistants	1898–1902
7	Forts, etc. (allotments, operations, etc.)	1829–1912
8	Charleston, S. C.—Fort Sumter	1829–1886
9	Castle Pinckney, Shutes Folly Island	1829–1880
10	Fort Moultrie, Sullivan Island	1841–1896
11	Fort Johnson, James Island	1870–1880
12	Lift battery, three 12-inch rifles	1895–1896
13	Mortar battery	1896–1900
14	10-inch battery	1897–1901
15	12-inch battery	1898–1902
16	4.7-inch R. F. guns	1898–1899
17	6-inch R. F. gun, pedestal mount	1898–1899
18	Three emplacements, 15-pounder R. F. guns	1899–1902
19	Emplacement, 6-inch R. F. gun, disappearing carriage	1899–1900
20	Port Royal, S. C.—R. F. guns	1898–1899
21	Siege battery	1898
22	10-inch battery	1898–1901
23	8-inch rifle	1898–1899
24	Dynamite guns	1901–1902
25	Georgetown, S. C.—Batteries	1898–1899
26	Preservation and repairs	1898–1902
27	Range and position finders	1896–1901
28	Sites	1891–1901
29	Submarine mines	1892–1902
30	Supplies	1901–1902

Part 1, FSN. Contracts.

1896. Two emplacements for 10-inch guns, $110,813.56. **97,** 698.

1897. One emplacement for 10-inch rifle, $66,612.80. **98,** 700.

1898. Ammunition hoist, $1,950; trolley system, $2,355. **98,** 702. Electric-light plant, $5,542. **99,** 860.

Part 2, FSN. Engineering Features.

Ammunition, hydraulic lifts. **05,** 3015 (pl.).

Borings, description of. **96,** 503.

Briquettes, method of making. **96,** 507.

Cement, tests. **96,** 505.

Closing cracks. **03,** 2411.

Concrete, placing with traveling derrick. **99,** 866.

Doors; steel doors, telautograph niches. **04,** 3722 (pl.).

Linings, magazines. **03,** 2410 (pl.); **04,** 3722.

Materials, itemized cost. **96,** 512.

Percolation, asphaltum as a preventive. **03,** 2412.

Planes of weakness, effects of settlement. **96,** 693.

Plant, constr.; arrangement of. **96,** 694; **98,** 705.

Plant, briquette-making. **96,** 516.

Plant, constr., itemized cost. **96,** 512.

Plant, electric, description. **00,** 915.

Plant, stone-crushing (tracing). **96,** 516.

Quarry and plant, description and cost. **96,** 512.

Settlement of mortar battery. **00,** 911.

Waterproofing, unsuccessful. **00,** 912. Methods. **03,** 2409 (pl.).

Well, artesian; strata passed. **96,** 504.

Well-points, description of. **96,** 509.

Part 3, FSN. Engineers.

Chief of Engineers. R., **66**, 14; **69**, 16; **70**, 23; **71**, 19; **72**, 16; **73**, 17; **74**, 20; **75**, 21; **76**, 22; **77**, 18; **78**, 21; **79**, 25; **80**, 42; **81**, 42; **82**, 39; **83**, 35; **84**, 41; **85**, 34; **86**, 34; **92**, 8; **93**, 9; **94**, 13; **95**, 10; **96**, 17; **97**, 16, 675; **98**, 24, 697; **99**, 26, 859, **00**, 24, 911; **01**, 6, 25; **02**, 7, 25; **03**, 9; **04**, 5; **05**, 5; **06**, 5; **07**, 5; **08**, 9; **09**, 10; **10**, 12; **11**, 8; **12**, 7.

Part 4, FSN. Board of Engineers.

Constituted, 1882, to consider and report upon the condition of fortifications, and what number, if any, could be dispensed with. R., **82**, 422.

Part 5, FSN. Engineers in Charge.

Col. Q. A. Gillmore, 1870–83.
Capt. J. C. Post, 1883.
Maj. F. V. Abbott, 1893–1897.
Lt. E. R. Stuart, 1897.
Maj. E. H. Ruffner, 1897–1900.
Capt. J. C. Sanford, 1900–02.

Part 6, FSN. Assistants.

Lt. E. H. Schulz, 1898–99.
Lt. E. R. Stuart, 1897–98. R., **97**, 690.
Lt. H. B. Ferguson, 1897.
Lt. C. Keller, 1898.
Lt. Edw. R. Stewart, 1901–02.

Civilian electrician. 1902. $1,200 allotted for pay. **02**, 725.

Part 7, FSN—

FORTS AND BATTERIES.

Part 8, FSN. Charleston Harbor, S. C.—Fort Sumter.

1829. Work begun. **80**, 42.

1866. Fort a mass of ruins. **66**, 14.

1870. Modification plans approv. for armament of heavy guns in barbette; est., $87,000. Work begun removing old wooden bombproofs and galleries; temporary sally port excavated on w. front, and wooden dock built; foundations of new scarp wall on se. face prepared; casemate arches of second tier, w. face, removed, and a large amount of filling placed on parapets of several fronts; minor work. **70**, 23.

1871. $25,000 app. Sand parapets raised about 7′ along entire length of n. face. **71**, 19.

1872. $35,000 app. Scarp wall of e. half of gorge and the entire se. face built; broken arches in rear removed and site leveled; surface magazine built on se. face; casemates of ne. face uncovered; those of second tier of this face were removed and scarp wall cut down; middle casemates uncovered and sites of two 15-inch guns prepared; 2 cisterns of 2,700 and 3,500 gallons capacity, respectively, built. **72**, 16.

1873. $40,000 app. Parapet on e. face and for a length of 57′ on the gorge face completed. Ne. face—flagging over casemate arches removed and scarp wall cut down to proper height; 10 casemate arches strengthened and 12 retaining walls built, and minor work. **73**, 18.

1874. $20,000 app. Repairs to 11 of the casemates completed and 11 guns mounted; 1 retaining wall built and earth filling in rear completed; minor work; raising scarp wall of ne. and nw. faces, and casemate arches of ne. face covered with concrete; 2 barbette service magazines built; terreplein of ne. face completed; timber gun platforms for 15-inch guns laid, and minor work. **74**, 21.

1875. Old wooden bombproof galleries excavated and removed; arches of 11 casemates strengthened and asphalted; 4 retaining walls built in rear of these casemates; masonry of new sally port front and gallery, the barbette service magazine, the foundations for platforms for guns Nos. 1, 2, and 3 on nw. front, and the passageways through parados in the angles between that front and the adjoining front completed; 2 cisterns, capacity 10,000 gallons each, built; 1 platform ready for gun, and minor work. **75,** 21.

1876. Storage magazine, breast-height walls, and permanent platforms for guns Nos. 1, 2, and 3, completed; entire scarp wall of nw. and gorge fronts coped with concrete; minor work. **76,** 22.

1877. Timbers of platforms 9 and 10 stored. Slopes repaired; minor work. **77,** 18.

1878. Wharf extended 30′. Two 15-inch guns and two 200-pounder Parrott rifles mounted on 15-inch timber platforms. **78,** 21.

1879. Preservation and repair—covering of marsh grass placed over the unfinished roof-surface of the principal magazine. **79,** 25.

1880. History, and importance of work. **80,** 42.

1881. Replacing with a timber revet. the old marsh sod revet. in front of guns 6 and 7 on the ne. face, and guns 9 and 10 on the se. face; beginning the extension of the wharf. **81,** 43.

1882. Parapet repaired, storage magazine covered with marsh grass, new wharf built about 350′ long; minor work. **82,** 40.

1883. Cribs of new wharf filled with riprap. Sand removed from the casemates of the ne. front, from the galleries, and from the passages leading to magazines; temporary wooden doors made and hung. Slopes and quarters repaired. **83,** 36.

1884. Timber breast-height walls for guns Nos. 8 and 9, se. face, repaired; coping placed for all entrances of covered passages of the nw. face; chimneys raised; cisterns, slopes, and quarters repaired. **84,** 42.

1885. Buildings repaired, superstr. of wharf, strengthened, and slopes repaired. **85,** 35.

1886. Preservation and repair—slopes, wharf, and earthwork repairs. **86,** 35.

Part 9, FSN. Charleston Harbor, S. C.—Castle Pinckney, Shutes Folly Island.

1829. Work begun. **80,** 43.

1866. Masonry was covered, during the rebellion, with sand and made into a powerful earthwork. **66,** 14.

1870. Recom. approv. that the existing condition be temporarily maintained with moderate repairs, and that guns of medium size be mounted on wooden platforms in the several emplacements already prepared for them. **70,** 23.

1880. In its existing condition the work useless for defensive purposes; in charge of the Lighthouse Board for lighthouse purposes. **80,** 43.

Part 10, FSN. Charleston Harbor, S. C.—Fort Moultrie, Sullivan Island.

1841. Work begun. **80,** 42.

1866. Fort converted by the Confederate forces during the rebellion into a powerful earthwork. Armament inadequate for modern defense. **66,** 14.

1870. Modification plans approv. for guns of largest caliber; est., $75,000. **70,** 23.

1871. $25,000 app. **71,** 19.

1872. $35,000 app. Removal of old platforms, flagging of terreplein, the breast-height parade, tie walls, palmetto crib traverses on the terrepleins, and the heavy wooden bombproofs on the parade and adjacent to the scarp wall; scarp wall uncovered and repaired; 3 service magazines in the s., se., and sw. faces completed, except doors; and the foundation and platform for two 15-inch guns laid. The bricks from Confederate Fort Ripley were transferred to this fort. **72,** 16.

1873. $40,000 app. Brick coping of scarp wall on the 3 chan. fronts built; masonry of principal and the adjacent service magazine on the e. face finished; earth filling of parapet and traverses on the 3 chan. fronts nearly finished. All brick and concrete work of the 2 small flanking bastions of chan. front removed; minor work. **73,** 17.

1874. $20,000 app. Masonry of ne. bastion magazine completed; wing walls, lintels, and caps added to 3 other service magazines; earth covering placed for the first, second, and third magazines; concrete masonry of the bombproof gallery e. of sally port completed; sally-port gallery raised; terreplein in rear of guns graded; work on parados; platforms for 4 of the largest seacoast mortars laid in rear of fort, and mortars mounted. Minor work. **74,** 21.

1875. $15,000 app. Work on parapet on sw. and w. fronts and sw. angle; sally port on gorge face completed, and masonry of the sally port and casemates and sally-port gallery nearly completed; sand covering of old storage magazines removed, drain repaired; 7 platforms ready for guns; minor work. 75, 21.

1876. Old storage magazine remodeled, and a service magazine, permanent platform, and breast-height wall for gun No. 12 completed; postern front completed, and foundation walls of the galleries leading to it were raised; minor work. 76, 22.

1877. Preservation and repair. 77, 18.

1878. Preservation and repair. Two 15-inch guns mounted on timber platforms. 78, 21.

1879. Preservation and repair. 79, 25.

1881. Exposed concrete over the sally port and guard rooms covered to protect it from the weather; general repairs of quarters and fences, etc. 81, 42.

1882–83. Wooden covering placed on principal magazine; repairs of quarters and grounds. 82, 39; 83, 36.

1884. Slopes repaired, graded, and sodded, and fort-keeper's house repaired. 84, 41.

1885. Preservation and repairs—fences and slopes. 85, 34.

1886. Preservation and repair. 86, 34.

Part 11, FSN. Charleston Harbor, S. C.—Fort Johnson, James Island.

1870–74. Modification plans approv.—to be repaired and maintained as an earthwork with such alterations and enlargements as will adapt the emplacements of 15-inch guns. 70, 23. Approv. projs. 74, 22.

1876. Four 13-inch mortar platforms on hand. 76, 23.

1880. Description of this work; a fort only in name, having neither armament nor magazines. 80, 43.

Part 12, FSN. Charleston Harbor, S. C.—Lift Battery for Three 12-Inch Rifles.

1895. $75,500 allotted. 95, 11.

1896. Work begun, 1895. 1,500 t. large st. procured for $393. Borings made; wharf built by contract. Artesian well bored under informal agreement; cost, $896.64. Work begun on scarp wall, and completed. Total cost, $3,299.90. Work suspended, and funds transferred to the mortar battery. 96, 502.

Part 13, FSN. Charleston Harbor, S. C.—Mortar Battery.

1896. $60,000 transferred from 12-inch emplacements, and $42,222 allotted. Work begun in Mar. Borings made, canal and basin dr.; wharf built, and 5 bins for st. constr. Pile driving begun Apr. 20, 1896; 330 piles driven by the end of the year, completing the piling for 7 mortar platforms. Seven mortars and carriages received. Excavation for mortar pits begun; ground drained of water with well-points. 96, 508.

1897. $112,000 allotted. Concrete work begun, and 15,562 c. y. placed; 107,816 c. y. sand placed in parapet and covered with 9,000 c. y. mud; 1,388 sq. y. sod placed round the tops and on the steep slopes. One mortar and 5 carriages received, and 8 mortars and 16 carriages mounted. 97, 675.

1898. $7,000 allotted. Concrete ramps in pits finished and 3 inches of granolithic covering placed: all floors put in; magazine doors built; settlement continued; mortars releveled: remaining 8 mortars received and mounted. 98, 697.

1899. Slopes graded, floors of interior galleries, shell rooms, and recesses raised 6 to 9 inches. Completed battery turned over to the Artillery. 99, 859.

1900. Total settlement of battery to Nov., 1899, 1.49′ at n. end, 1.66′ at s. end, and 1.47′ in middle. Floors of magazine raised about 1′. Wire fence built on 3 sides of reservation. 00, 911.

Part 14, FSN. Charleston, S. C.—10-inch Battery.

1897. $160,000 allotted. Plans approv. for shifting battery 400′ w. of site selected by BE. Battery to be built under contract. Artesian well begun. Concrete work and sand filling in progress. Shot lifts in position. No armament. **97,** 693.

1898. $75,000 allotted. Three guns and carriages received and mounted. Artesian well, 1,308′ deep, dug, and 3 gun emplacements completed, except electric plant. Work begun under contract on a fourth emplacement completed. **98,** 698.

1899. $3,100 allotted; electric plant installed and completed and turned over to the garrison. $1,610 allotted for constr. of 2 cisterns, each to contain 30,000 gallons of water; work begun and completed. **99,** 860, 861.

1901. $500 allotted. Repairs to ammunition hoists; work completed. **01,** 817. $1,125 allotted for constr. galleries; work completed. **01,** 818.

Part 15, FSN. Charleston Harbor, S. C.—12-inch Battery.

1898. $50,000 allotted. Work begun on 1 emplacement for a 12-inch disappearing gun on U. S. carriage, model 1896. Platform ready for base ring by May 14. $40,000 allotted. Work begun on 1 emplacement for a 12-inch barbette carriage; platform nearly completed. 400 c. y. Portland and 2,500 c. y. natural cement placed. No armament on hand. **98,** 700.

1899. $7,200 allotted for the emplacement for disappearing carriage. Total of 11,000 c. y. concrete placed in both emplacements; shot lifts and trolleys erected; 2 cisterns built under loading platforms in spaces which would otherwise have been filled with sand; retaining wall built behind both emplacements to the height of the loading platform. $1,600 allotted for mounting guns and carriages. Barbette gun and carriage mounted; disappearing gun carriage mounted; gun not yet received. Battery completed, except electric lighting and erection of cranes and hand railing. Minor repairs made. **99,** 863, 864.

1900. 12-inch rifle for disappearing carriage received and mounted. $5,000 allotted, and electric-light plant installed. Battery turned over to the Artillery. **00,** 914.

1902. $18,800 allotted for completion of work on battery; masonry work completed; front wall cut down and new coping built; filling done; repairs to wall, etc. **02,** 723.

Part 16, FSN. Charleston Harbor, S. C.—4.7-inch R. F. Guns.

1898. $6,000 allotted Apr. 6 for 2 emplacements. Work begun, and 2 emplacements and 1 magazine, except roof, completed by May 1. **98,** 702.

1899. Completion of gallery and drains; mounting guns; covering parapet with an apron of 6-inch concrete. Completed battery turned over to the Artillery. **99,** 861.

Part 17, FSN. Charleston Harbor, S. C.—6-inch R. F. Gun on Pedestal Mount.

1898. $8,000 allotted for 1 emplacement. **98,** 703.

1899. $7,500 allotted. Work begun in Oct., 1898, and completed. Gun and carriage mounted by Artillery. **99,** 861.

Part 18, FSN. Charleston Harbor, S. C.—Three Emplacements for 15-Pounder R. F. Guns.

1899. $9,500 allotted. Work begun removing an old 15-inch gun, 750 c. y. sand, and 140 c. y. of old concrete. Battery completed, except setting base castings. **99, 861.**

1900. Guns, carriages, and base casting not yet received. **00, 913.**

1901. Base castings, guns, and mounts received; castings set; guns mounted. **01, 816.**

1902. Turned over to Artillery July 16, 1901. **02, 724.**

Part 19, FSN. Charleston Harbor—Emplacement for 6-inch R. F. Gun on Disappearing Carriage.

1899. $20,000 allotted. Work begun in April and 635 c. y. concrete placed in walls and 450 c. y. sand placed in parapet. **99, 862.**

1900. 1,100 c. y. concrete placed and 2,400 c. y. sand for parapet. Carriage received and mounted. Battery completed, except mounting gun, and turned over to the Artillery. **00, 913.**

Part 20, FSN. Port Royal, S. C.—R. F. Guns.

1898. $6,000 allotted April 6 for 2 4.7-inch R. F. guns; work begun; 350 c. y. concrete placed and guns mounted by June 24. **98, 704.**

1899. Grounds graded; parapet protected with oyster shells and battery completed. **98, 868.**

Part 21, FSN. Port Royal, S. C.—Siege Battery.

1898. $2,000 allotted for temporary battery for one 5-inch B. L. siege gun and one 7-inch B. L. siege howitzer. Work begun and completed, ready for mounting the guns which were on hand. Orders received to ship them to Tampa, Fla. Two light 12-pounders received and mounted on wooden platforms, so as to fire over parapets. One of the magazines is used as a mining casemate and the other for storage purposes. **98, 704.**

Part 22, FSN. Port Royal, S. C.—Ten-inch Battery.

1898. $89,000 allotted. Work begun on 2 emplacements and 454 c. y. concrete placed in gun blocks, completing same. **98, 705.**

1899. $50,000 allotted. Work begun on an addl. emplacement; 11,010 c. y. concrete and 14,500 c. y. sand placed; ammunition hoists and trolley systems installed and 2 carriages mounted. **99, 865.**

1900. Remaining carriage and 3 rifles mounted by Artillery; cranes erected; hand railing put up; barbed-wire fence built; electric plant installed and tested. Completed battery turned over to the Artillery. **00, 915.**

1901. Materials used for constr. taken down and stored. **01, 820.**

Part 23, FSN. Port Royal, S. C.—Eight-inch Rifles.

1898. $12,000 allotted for temporary battery for two 8-inch rifles mounted on 15-inch carriages. Site changed. Work begun on wharf. **98, 706.**

1899. Guns mounted and all work completed. **98, 869.**

Part 24, FSN. Port Royal, S. C.—Dynamite Battery.

1901. $50,000 allotted for pneumatic dynamite battery. **01,** 820.

1902. July 24, 1901, Sec. of War ordered work to be stopped. **02,** 727.

Part 25, FSN. Georgetown, S. C.—Batteries.

1898. $5,000 allotted. Temporary batteries for two 7-inch B. L. howitzers built, requiring the use of 6,000 sandbags and 1,500 c. y. sand to fill in between the walls; emplacement built and howitzer mounted. Two 5-inch B. L. rifles mounted in the old fort prepared for them. Orders received to ship all ordnance and ordnance stores at Georgetown to Tampa, Fla. These guns were replaced by four 12-pounder guns, which were mounted. **98,** 766.

1899. Twelve-pounder guns removed. **99,** 870.

Part 26, FSN. Preservation and Repair.

1898. Charleston H.—$1,800 allotted for mounting 15-inch S. B. guns on emplacements 5, 6, 7, and 8 of old fort; 2 guns mounted. **98,** 703.

1899. Charleston H.—$1,500 allotted for painting I beams and repairing shot lifts and drains of 10-inch battery. **99,** 862. $382.46 expended on minor repairs of 12-inch emplacement. **99,** 864.

1900. Charleston H.—$3,800 allotted for repairs of electric plant, building wire fence, prevention of leakage in magazines (unsuccessful), and minor work on plant. $500 allotted for caring for torpedo material, building a dust-proof room for torpedo material, and minor work. **00,** 912, 913. $500 allotted for completing guardrail, erecting cranes, and building wooden sheds over passages to keep out the rain. **00,** 914.

Port Royal—$2,500 allotted for repairs of wharf; 126 piles protected by yellow metal driven; work completed. **00,** 915. $500 allotted for repairs of torpedo material; work completed. **00,** 916. $200 allotted for estab. a bench mark; work completed. **00,** 916.

1901. $2,000 allotted. Charleston H., S. C.—misc. work of alteration and repair. **01,** 817. $800 allotted for painting ironwork, 12-inch battery. **01,** 818. Repairs to hoists at 10-inch battery. Port Royal—painting and whitewashing, etc., done. **01,** 820.

1902. Charleston H., S. C.—$150 allotted. Repairs and painting at 10-inch, 12-inch, and mortar batteries. **02,** 724. $300 allotted for imp. lifts, repairs to ammunition hoists and outlet drain. **02,** 725. $1,950 allotted. Work on damaged portion of sloping wall. **02,** 725. $1,300 allotted. Port Royal—cleaning and painting; board walk built; plant removed. **02,** 727.

Part 27, FSN. Range and Position Finders—Charleston Harbor, S. C.

1896. Station built in rear of the mortar battery. **96,** 517.

1901. $5,100 allotted for battery-commander's station; no work done. **01,** 819.

1902. $4,961.66 withdrawn and returned to Treas. **02,** 726.

1901. $160 allotted for plotting and observation station; constr. completed. **01,** 819.

Part 28, FSN. • Sites—Sullivans Island.

Sec. of War requested the cooperation of the governor of South Carolina in obtaining the passage of an act ceding the title to, and jurisdiction over, the sites of these 3 batteries to the U. S. **91,** 13. Title granted to the U. S. on condition that the U. S. compensate all persons having any right, title, or interest in any part of the land in question. **95,** 14. Twenty-one lots purchased at cost of $31,332. Negotiations in progress for remainder of the land. **96,** 17. Title to all land acquired for 10-inch and 12-inch batteries, except 4 lots, which were condemned; papers awaiting the opinion of the Attorney General. **97,** 17. $2,175 allotted for purchasing sites. **00,** 916.

1901. $40.95 allotted. Lots Nos. 58 and 59 paid for. **01,** 821.

Part 29, FSN. Submarine Mines.

1892. Charleston H.—1 mining casemate nearly completed. **92,** 8.

1893. Charleston H.—mining casemate completed; cost, $13,100. **93,** 9.

1898. Charleston H.—cable tank built at mortar battery. Mines planted, kept in order, and mine fields patrolled. **98,** 25, 698.

1899. Charleston H.—$5,000 allotted. All mines removed by exploding them; material cleaned and stored. 24-inch searchlight outfit transferred to the engineer officer. $1,900 allotted for a new mining casemate, the existing one found to be unsuitable. accomplished by converting an old magazine in the fort; addl. cover obtained by placing concrete and sand. **99,** 865. Port Royal H.—mines planted July 28, and removed by exploding them in August; material stored. $3,000 allotted for cable tank; work begun and completed and a movable hoist installed. **99,** 869.

1900. Charleston H.—200 c. y. sand and 200 c. y. marsh mud placed on slopes. **00,** 914. Port Royal—drums of cable removed from cable tank, tested, insulated, and replaced. **00,** 915.

1901. $6,500 allotted for constr. torpedo storehouse; contract awarded, but no work done. **01,** 819. Care of torpedo material. **01,** 819, 821.

1902. Constr. of torpedo storehouse completed. **02,** 727. $1,500 allotted for cable tank, Charleston H.; no work done. **02,** 726.

Part 30, FSN. Supplies for Seacoast Defenses.

1901. $800 allotted. Requisitions received and filled. **01,** 819.

1902. $500 allotted. Requisitions received and filled. **02,** 726.

FSO. FORTIFICATIONS OF GEORGIA AND CUMBERLAND SOUND, GA. AND FLA.

(Note.—Reports on these works from 1903 to 1912 are of a general character only. See the first 15 pages of each annual report from 1903 to 1912.)

Part.	Title	Period.
1	Contracts	1880-1900
2	Engineering features	1897-1905
3	Engineers—Chief of Engineers	1866-1912
4	BE	1879-1895
5	In charge	1866-1912
6	Assistants	1896-1900
7	Forts, etc. (operations, allotments, etc.)	1829-1912
8	Savannah—Fort Pulaski	1829-1889
9	Fort Jackson (Oglethorpe)	1842-1886
10	Tybee Isld	1872-1886
11	Four 8-inch rifles, disappearing carriages	1897-1899
12	Two 12-inch B. L. rifles, barbette carriages	1898-1899
13	R. F. emplacement	1898
14	Emplacements, eight 12-inch mortars	1898-1901
15	Emplacements, three 4.7-inch R. F. guns	1899-1900
16	Site 1—Emplacements, two 15-pounder R. F. guns	1899-1900
17	Site 2—Emplacements, two 15-pounder R. F guns	1899-1900
18	Wassaw Sound, R. F. emplacement	1898-1899
19	Darien, Ga.—Temporary defenses	1898-1899
20	Brunswick, Ga.—Temporary defenses	1898-1899
21	Cumberland Sound—Fort Clinch	1897-1898
22	Emplacement, 8-inch B. L. rifle	1898-1899
23	Temporary batteries	1898-1899
24	Fernandina, Fla.—Temporary batteries	1898
25	Miscellaneous (overhauling 15-inch guns and platforms; removing materials from temporary batteries; galleries)	1898-1901
26	Preservation and repairs	1898-1902
27	Range and position finders	1899
28	Submarine mines	1894-1901
29	Supplies	1901-1902

Part 1, FSO. Contracts.

1880. Five spur jetties, Ft. Clinch. **80,** 44.

1883. Raising spur jetties, Ft. Screven. **83,** 39.

1885. Work on spur jetties, Ft. Screven. **85,** 37. Repair of gun platforms, Ft. Pulaski. **85,** 36.

1897. Wharf, $15,361.72. Emplacements for four 8-inch guns, $126,881. **97,** 17, 700, 701, 702.

1900. Portland cement, 5,000 barrels, $2.47 per barrel. **00,** 919.

Part 2, FSO. Engineering Features.

Battery for 8-inch guns, details of construction, **98,** 708.

Cement testing. **00,** 918.

Concrete mixing. **99,** 872.

Cracks, repairs of. **99,** 870; **04,** 3724.

Guns, moving and mounting. **99,** 877.

Magazines, dampness in. **99,** 884.

Materials, constr., itemized cost. **98,** 709; **99,** 873; **00,** 917.

Mining casemate, temporary. **98,** 714.

Plant, arrangement of. **99,** 871, 876.

Portland cement specifications. **00,** 918.

Settlement of emplacements. **99,** 870.

Teredo, protection of piles against. **97,** 700.

Triangulation, base-line measurement for. **05,** 3016 (pl.).

Vegetable growth for holding sand. **99,** 879; **00,** 921.

Waterproofing. **99,** 871; **00,** 918, 920; **04,** 3723.

Wharf, description and cost. **97,** 700.

Part 3, FSO. Engineers.

Chief of Engineers. R., 66, 14; 67, 12; 68, 18; 69, 16; 70, 23; 71, 20; 72, 17; 73, 18; 74, 22; 75, 22; 76, 23; 77, 19; 78, 22; 79, 26; 80, 44; 81, 44; 82, 41; 83, 37; 84, 43; 85, 36; 86, 36; 93, 4; 94, 6, 10; 95, 5, 6, 11; 96, 17, 517; 97, 17, 700, 98, 25, 707; 99, 27, 870; 00, 25, 917; 01, 26, 821; 02, 26, 727; 03, 9, 13, 681; 04, 5, 9; 05, 5; 06, 5; 07, 5; 08, 9; 09, 10; 10, 12; 11, 8; 12, 7.

Part 4, FSO. Board of Engineers.

1879. Plans for modification of Ft. Clinch and for new exterior 12-inch battery. 79, 27.

1882. Constituted to consider and report upon the condition of fortifications, and what number, if any, could be dispensed with. 82, 423.

1895. Proj. adopted for defense of Savannah H. 93, 4; 95, 5.

Part 5, FSO. Engineers in Charge.

Maj. F. A. Sears, 1866.
Capt. J. W. Barlow, 1866–70.
Col. Q. A. Gillmore, 1869–86.
Capt. W. Ludlow, 1870.
Capt. J. C. Post, 1883.
Capt. O. M. Carter, 1894–98.
Capt. C. E. Gillette, 1898–1903, 1906. R., 99, 884.
Lt. Col. W. H. H. Benyaurd, 1899.
Capt. C. H. McKinstry, 1899–1900.
Lt. Col. S. B. Quinn, 1903-1906. R., 04, 3723 05, 3016.
Col. D. C. Kingman, 1906.

Part 6, FSO. Assistants.

Lt. H. Burgess, 1898.
Lt. H. S. Morgan, 1898–99.
Lt. C. S. Bromwell, 1898–99.
Lt. Lytle Brown, 1899–1900.
Lt. E. M. Markham, 1900.

Part 7, FSO—

FORTS AND BATTERIES.

Part 8, FSO. Savannah, Ga.—Fort Pulaski, Cockspur Island, Mouth of Savannah River.

1829. Work begun. 80, 44.

1869. Work begun preparing to mount armament—brick and st. masonry work, repair of gun platforms, taking up and resetting traverse sts. and rails to restore the proper radius and level; thorough repair of the water battery and constr. of 6 wooden platforms for 100-pounder rifles. 69, 16.

1870. Est. cost of approv. modifications, $53,000; necessary repair of gun platforms to enable guns on hand to be mounted; wooden wharf built. 70, 24.

1871. $26,500 app. 71, 20.

1872. $25,000 app. Necessary temporary buildings erected; old gun platforms and breast-height wall of the demilune removed; scarp wall of both faces raised; exterior and superior slopes rearranged and sodded; old terreplain excavated for piling and grillage for the guns and magazines of the n. face and the center pintle gun at the salient; constr. of the grillage for 2 guns in the ne. angle; driving of piling for the adjacent service magazine; replacing the drawbr. over the demilune ditch; and minor work. 72, 17.

1873. $50,000 app. Completion of sand filling over grillage, retaining wall in rear of gun platforms and the breast-height wall for 2 gun platforms; scarp wall of the gorge face raised; new pile driver built; grillage laid for the adjacent service magazine to guns 8 and 9, n. face; concrete of magazine and passageway and earth filling around them carried to height of magazine floor; piling for foundation of gun platforms 6 and 7 completed; breast height and retaining wall of foundation commenced, and minor work. 73, 18.

1874. $20,000 app. Completion of breast-height wall and concrete foundations of gun platforms 8 and 9; masonry of service magazine and passageway between guns 7 and 8; work on service magazines bet. guns 3 and 4, and 5 and 6; excavation for foundation of storage magazine; and work on platforms 4, 5, 6, and 7; parapet constructed and 2 guns of approv. caliber mounted on 8 and 9, and minor work. Summary of work. **74,** 23.

1875. $25,000 app. Parapet on n. and s. faces of demilune nearly completed; all gun platforms laid; work on parados. All doors made and hung and minor work. Summary of work. **75,** 23.

1876. Entire demilune nearly completed; retaining wall rebuilt; modification work begun. New piers on n. front raised. **76,** 23.

1877-79. Preservation and care. **77,** 19; **78,** 22; **79,** 26.

1882. Repairs to buildings and brs. **82,** 41.

1883. Wooden fronts of casemates and magazine roof renewed; repairs to wharf. **83,** 38.

1884. Concrete masonry covered with sand up to grade and slopes sodded; dikes repaired. **84,** 43

1885. Buildings repaired; contract made for repairing 20 permanent platforms for 8-inch and 10-inch Rodman guns on the barbette of the main work. **85,** 36.

1886. Twenty platforms repaired; general repair of work. **86,** 36.

1898. $2,800 allotted. Temporary platform for 8-inch B. L. rifle built of concrete in one of the old forts (Pulaski) and gun and carriage mounted. **98,** 710. $1,950 allotted. Two 15-inch guns and their carriages lifted out of the emplacements, timber platforms replaced by concrete ones, and guns and carriages remounted. **98,** 711.

1899. Gun dismounted and carriage shipped away by the ordnance officer. Balance of $36.37 transferred. **99,** 880.

Part 9, FSO. Savannah, Ga.—Fort Oglethorpe,[1] Savannah River.

1842. Work begun. **80,** 44.

1870. Est. cost of approv. modifications, $16,000. **70,** 23.

1872. $15,000 app. **72,** 17.

1873. Modification work begun. Casemate arches reinforced, scarp wall raised, and breast-height wall completed; parade wall partly rebuilt and raised; 2 earthen traverses removed ftom terreplein and the material used to fill in the parapet. **73,** 18.

1874. Parapet and breast-height wall finished, parade wall raised, and concrete foundations for guns 1, 2, 4, and 5 built, and gun platforms laid. Temporary armament of 5 guns mounted; 10-inch S. B. in positions 1, 2, and 3 and 100-pounder Parrott rifles in positions 4 and 5. **74,** 22.

1876. Service traverse magazine built between guns 3 and 4 of barbette battery. **76,** 23.

1882. Repairs to brs. and doors. **82,** 41.

1883. Wharf repaired and grass cut. **83,** 37.

1884. Two casemates fitted up as storage rooms for engineer property and grass on slopes cut. **84,** 43.

1885-86. Repairs to br. and buildings. **85,** 36; **86,** 36.

Part 10, FSO. Savannah, Ga.—Fort Screven, Tybee Island, Mouth of Savannah River.

1872-73. Plans in progress. **72,** 18; **73,** 19.

1874. Surveys made. **74,** 23.

1875. Necessary land acquired and its boundary marked with st. monuments. **75,** 23.

1876. Plans completed. **76,** 24.

1882. Three jetties built, 590′, 750′, and 650′ long. **82,** 42.

1883. $5,000 allotted from app. for preservation and repair of fortifications and contract let for increasing height of jetties. **83,** 38.

1884. Some work done on jetties. **84,** 44.

1885. Addl. work on jetties to be done under contract. **85,** 37.

1886. Jetty No. 2 extended. **86,** 37.

1893. Project adopted. **93,** 4.

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[1] This work was called Ft. Jackson until 1884.

Part 11, FSO. Savannah, Ga.—Four Emplacements for 8-inch Rifles, Disappearing Carriages.

1897. $155,000 allotted. Work begun under contract; 2,864 c. y. excavated. Wharf completed under contract; description. **97,** 700.

1898. $23,950 allotted. 17,400 c. y. concrete placed; all work completed and 4 guns and carriages mounted. Summary of work. **98,** 709.

1899. $6,000 allotted. Slopes sodded, traverse circles extended, and field of fire of each gun increased about 10°; settlement repaired. **99,** 870.

Part 12, FSO. Savannah, Ga.—Emplacements for Two 12-inch B. L. Rifles, Barbette Carriages.

1898. $40,000 allotted. Work begun; excavation for platforms completed; some concrete work. Four telephone booths built. **98,** 709.

1899. $81,100.19 allotted. Emplacements completed. Description of work. $80 allotted. A 3-inch artesian well sunk to a depth of 90′. **99,** 876.

Part 13, FSO. Savannah, Ga.—Rapid-fire Emplacement.

1898. $180.71 allotted. Work begun, some materials purchased, and some excavation made. Notice received that guns could not be procured; work stopped and materials transferred to other works. **98,** 710.

Part 14, FSO. Savannah, Ga.—Emplacements for Eight 12-inch Mortars.

1899. $108,132 allotted. Work begun in December, 1898; excavation and nearly all of concrete work completed; description and cost of material and labor. **99,** 871.

1900. $17,310 allotted. Guns mounted and battery, built of Portland cement, completed and turned over to the Artillery; cost, $125,442; summary of work. **00,** 917.

1901. $4,800 allotted for supplying electric-light plant and placing grounds in good condition; pavement rear of battery repaired; drains lowered; grounds cleaned. **01,** 822.

Part 15, FSO. Savannah, Ga.—Emplacements for Three 4.7-inch R. F. Guns.

1898. $9,000 allotted. Work begun and practically completed; minor work, including mounting of gun and carriage, to be done. **98,** 710.

1899. $14,800 allotted. Guns were temporarily mounted at defense of Wassaw Sound, then transferred to a new site in process of constr. Nearly all concrete work and fill completed. **99,** 875. $5,582 allotted. $225 transferred to other allotments and 32¢ deposited with Treas. U. S. Parapet sodded, gun and carriage mounted, and the completed battery turned over to the Artillery, **99,** 876.

1900. $1,585 allotted. Guns mounted and battery completed. Summary of work. **00,** 919.

1901. Battery turned over to the Artillery. **01,** 26.

Part 16, FSO. Savannah Ga.—Site 1—Emplacements for Two 15-pounder R. F. Guns.

1899. $100 allotted. No work. **99,** 878.

1900. $9,430 allotted. Work begun Oct. 14, 1899, and battery completed by Mar. 31, 1900, except setting fixed ironwork for guns. Summary of work. **00,** 920.

Part 17, FSO. Savannah, Ga.—Site 2—Emplacements for Two 15-pounder R. F. Guns.

1899. $12,800 allotted for protection of mine fields. 1,800 c. y. sand placed in foundations; also 30,000 old brick. A 3-inch artesian well, 122′ deep, driven. Minor work. **99,** 880.

1900. Battery completed except setting of fixed iron work for guns. **00,** 921.

1901. Unexpended balance of $82.27 deposited. **01,** 824.

Part 18, FSO. Savannah, Ga.—Rapid-fire Emplacement at Wassaw Sound.

1898. $11,000 allotted. Work begun. Two emplacements for 4.72-inch guns mounted and battery completed at end of fiscal year. **98,** 711.

1899. Guns dismounted and removed to a permanent site. $725 transferred to other allotments, and $25.84 trans. to Treas. U. S. **99,** 879.

Part 19, FSO. Darien, Ga.—Temporary Defenses.

1898. $10,000 allotted. Battery at s. end of Sapelo Isld.; magazine built and covered with sand; parapet and magazine covered with grass sod; small well driven and supplied with pump. Battery at n. end of Blackbeard Isld.; magazine built with timber and covered with sand. **98,** 712.

1899. Batteries damaged by storm; repairs made. $988.47 trans. and deposited. **99,** 882.

Part 20, FSO. Brunswick, Ga.—Temporary Defenses.

1898. $12,000 allotted. Temporary batteries built at s. end of St. Simons Isld., and 1 e. of it; n. end of Jekyl Isld., and 1 at s. end of Jekyl Isld. **98,** 712.

1899. Artesian well sunk on Jekyl Isld., and 1 at St. Simons Isld. Batteries damaged by storm. **99,** 882.

Part 21, FSO. Cumberland Sound—Fort Clinch (Amelia Island, Fla.).

1847. Work begun. **80,** 44.

1866. Curtain galleries connecting the parade with the terreplein of the chemin-de-ronde constr., excavation for them filled in, and the ramparts made ready to receive the barbette gun platforms. Work on exterior parados wall and filling of the glacis. **66,** 14.

1867. Four platforms, ne. and nw. curtains, completed; 4 other platforms on the ne. and 6 on the nw. nearly completed; foundations of breast-height wall on 3 fronts laid, terreplein formed, graded and seeded; work on exterior wall of parados, drainage, quarters, and minor work. **67,** 12.

1868. Main sewer completed; drawbr. gateway nearly finished; completion of masonry of those gun platforms which had been begun. Work suspended; placed in charge of a keeper. **68,** 16.

1869. Preservation and care. **69,** 16.

1870. Modification plans; est. cost, $106,000. **70,** 24. **77,** 20.

1871-72-77. Preservation and care. 71, 20; 72, 18; 77, 20.

1879. Modification plans necessary for the reception of proposed armament of modern guns, and for a new exterior battery, completed. 79, 27.

1880. Jetties to be built under contract. 80, 45.

1881. Work on jetties and on roofing over the 5-tower bastions; repair of quarters. 81, 45.

1882. Five jetties completed and minor work. 82, 42.

1883. Jetties extended and 2 new spur jetties built. 83, 39.

1884. Break'r or protection of wood to preserve the engineer officers' quarters at Old Fernandina built and repairs made to buildings. 84, 44.

1885. Repairs made to 4 permanent front pintle platforms for 15-inch Rodman guns, and to 18 permanent front pintle platforms for 8-inch or 10-inch Rodman guns, or corresponding rifles; doorways leading to bastions repaired; roads across parade cleared of brush, etc., and beach protected with compressed brush mattress work loaded with st. 85, 37.

1886. General repair of buildings, etc. Old jetties repaired and two new ones built. 86, 37.

1898. $1,200 allotted. Temporary parapet of sandbags and sand fill constr. in front of two 15-inch Rodman guns. Platform built back of guns and crane built for shot hoist. Ammunition received; 30 shells shipped away. 98, 712.

1899. $137.03 returned to appropriation. 99, 886.

1901. $600 trans. from app. 01, 826.

1902. Balance of $679.58 deposited. 02, 728.

Part 22, FSO. Cumberland Sound—Emplacement for 8-inch B. L. Rifle.

1898. $4,500 allotted. Work begun on mounting 8-inch B. L. rifle on a modified 15-inch S. B. carriage; old pintle st. removed and a retaining wall of brick concrete built back of the emplacement; 1,500 c. y. sand placed in parapet. 98, 712.

1899. $2,826 allotted. Platform and sand fill completed; 15-inch carriage altered; gun mounted; and ammunition crane erected; work completed. $228.91 trans. from app. 99, 887.

Part 23, FSO. Cumberland Sound—Temporary Batteries.

1898. $1,600 allotted. Moat of the old work filled in; sand causeway built across moat at the sally port and cisterns baled out and filled with sand; artesian well sunk 386'; minor work. 98, 713.

1899. $287.41 returned to app. 99, 896.

Part 24, FSO. Fernandina, Fla.—Temporary Batteries.

1898. $2,000 allotted. Battery built at the n. end of Little Cumberland Isld. 98, 714.

1899. $1,376.45 returned to Treas. U. S. 99, 898.

Part 25, FSO. Miscellaneous.

1899. $313.12 allotted. 99, 880.

Removing material from temporary batteries. 1899. $500 allotted for cleaning guns, painting carriages, and removing ammunition and appliances from Brunswick and Darien defenses. Work completed. Balance of $61.47 transferred. 99, 883.

Bracketed galleries to connect gun emplacements. 1901. $1,600 allotted. Work of installation completed. 01, 822.

Part 26, FSO. Preservation and Repair.

1898. Cumberland Sound—$500 allotted for placing armament in serviceable order, repairing magazines, and for minor work. **98,** 715. Savannah H.—$500 allotted to imp. the sanitary condition of one of the forts. **98,** 716.

1899. Savannah H.—$1,050 allotted; ditches cleaned and the sand beach in front of batteries seeded. **99,** 879. $751.25 received. Parrott guns and carriages cleaned and inverted in casemates; wharf repaired; minor work. **99,** 881. Cumberland Sound—$1,175 allotted for repairs to buildings, etc. **99,** 887.

1900. $7,545 allotted. 12-inch emplacement—artesian well sunk 155′. Brush placed on sand to hold it down, and minor repairs. 8-inch emplacement—cracks closed; ironwork painted; machinery repaired; minor work. 6-inch battery—steps leveled; ceiling beams painted; minor work. 4.7-inch battery—ceiling beams painted; sand areas covered with stable manure and seeded; minor work on electrical apparatus. **99,** 920. Site 2—$775 allotted; cleaning ditches and moat; electrical apparatus and torpedo material; minor work. $200 trans. from app. **00,** 922.

1901. $4,600 allotted. Brush and manure spread over blowing sand areas; drains repaired; mortar battery overhauled and cleaned; 350 c. y. sand removed; minor repairs made. Poor condition of wharf described; cost of repair est. $16,000. **01,** 822. $400 for decreasing dampness in mining casemate. **01,** 824.

1902. $1,492.77 allotted; covering blowing sand, and minor repairs. **02,** 728. Drain holes cut in floors of magazines and storerooms of 3-inch R. F. battery. **02,** 728.

Part 27, FSO. Range and Position Finders—Savannah, Ga.

1899. $50 allotted. $26.50 returned. One range finder installed. **99,** 878.

Part 28, FSO. Submarine Mines.

1894. Savannah, Ga.—Mining casemate begun. **94,** 6, 10.

1895. Mining casemate completed. **95,** 11.

1898. $200 allotted—inverted arches below 2 adjacent casemates of the same fort cleaned and converted into tanks. **98,** 711. $2,500 allotted—temporary operating room built in sand dunes and shrubbery. $4,500 allotted for purchasing explosives and planting mines; mines planted. **98,** 714.

1899. Savannah, Ga.—$650 allotted for cable tank. **99,** 881. $500 allotted for removing mine material, cleaning, and storing same. **99,** 881. $750 allotted: $320.10 deposited with Treas. U. S.—temporary mining casemate built; minor work Two mines lost. **99,** 882. Cumberland Sound—$2,000 allotted for planting and removing mines and caring for the torpedo material. All mines removed by exploding them. $559.46 restored to appro. **99,** 887.

1900. All torpedo material cleaned and stored. **00,** 921, 922.

1901. $9,000 allotted for a mining casemate; work completed. $83.97 returned to appro. **01,** 823. $4,000 allotted for torpedo storehouse; bids too high; funds returned to Treas. **01,** 823. $500 allotted for fitting up casemate with operating tables, electric wiring, etc.; work completed. **01,** 824.

Part 29, FSO. Supplies for Seacoast Defenses.

1901. $300 allotted. **01,** 825.

1902. $300 allotted. Supplies furnished. **02,** 728.

FSP. EASTERN AND SOUTHERN FLORIDA FORTIFICATIONS.

(NOTE.—Reports on these works from 1903 to 1912 are of a general character only. See the first 15 pages of each annual report from 1903 to 1912.)

Part.	Title.	Period.
1	Contracts	1897–1898
2	Engineering features	
3	Engineers—Chief of Engineers	1866–1912
4	BE	1882
5	In charge	1866–1902
6	Assistants	1891–1901
7	Forts, etc. (allotments, operations, etc.)	1756–1912
8	St. Johns River—Temporary battery	1898–1899
9	Emplacements, two 8-inch B. L. rifles on strengthened 15-inch barbette carriages	1898–1899
10	St. Augustine—Fort Marion	1756–1900
11	St. Francis Barracks	1897–1898
12	Temporary battery	1898–1899
13	Miami—Tempoary battery	1898–1899
14	Key West—Fort Taylor and batteries	1844–1886
15	Emplacements, two 12-inch B. L. rifles, barbette carriages	1898–1900
16	Emplacements, four 10-inch guns, disappearing carriages (model 1896); two 8-inch guns, disappearing carriages (model 1894); and eight 12-inch rifled mortars	1897–1902
17	Emplacements, two 4.7-inch R. F. guns	1898–1900
18	Four emplacements, 15-pounder R. F. guns	1899–1901
19	Two emplacements, 15-pounder R. F. guns	1900–1901
20	Emplacement, right flank, 15-pounder R. F. gun	1901–1902
21	Dry Tortugas—Fort Jefferson, Garden Key	1846–1886
22	New fort	1866–1869
23	Miscellaneous (electric plant; pumping plant; civilian electrician)	1899–1902
24	Preservation and repairs	1897–1902
25	Range and position finders	1899–1902
26	Sites	1897–1902
27	Submarine mines	1897–1900
28	Supplies	1900–1902
	(See Nos. 29–47, on p. 1962 of this index.)	

Part 1, FSP. Contracts.[1]

1897. Emplacements for four 10-inch guns, two 8-inch guns, and eight 12-inch mortars, $378,992 97, 17, 713.

1898. Portland cement, $2.70 per barrel; Rosendale cement, $1.35 per barrel; silica sand, $1.66 per c. y.; coral sand, 70¢ per c. y.; broken brick (including crushing and hauling), $1.93½ per c. y. 99, 894.

Part 2, FSP. Engineering Features.

Brick, broken, for concrete. 99, 892, 894.

Cement, tests of Rosendale. 97, 706.

Concrete made with broken brick in place of broken st. 99, 892, 894.

Condensation. No trouble from, in "this" district. 03, 2413. Preventing condensation. 04, 3725.

Cracks in battery, methods of filling. 99, 897.

Crane, description of traveling. 99, 892.

Dampproofing, shell and powder magazines. 03, 2413 (pl.).

Emplacements, itemized cost of four 10-inch, two 8-inch, and eight 12-inch mortars. 97, 713.

Leakage, preventing (and cause). 03, 2413.

Percolation, preventing. 03, 2413; 04, 3725.

Plant, constr., description of. 97, 704.

Waterproofing methods. 99, 897.

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[1] See Leach contract, p. 1829 of this index.

Part 3, FSP. Engineers.

Chief of Engineers. R., **66**, 15; **67**, 13; **68**, 17; **69**, 16; **70**, 24; **71**, 20; **72**, 18; **73**, 19; **74**, 23; **75**, 23; **76**, 24; **77**, 20; **78**, 28; **79**, 27; **80**, 45; **81**, 45; **82**, 43; **83**, 39; **84**, 45; **85**, 38; **86**, 38; **91**, 11, 533; **92**, 15, 471; **96**, 18; **97**, 17, 702; **98**, 26, 716; **99**, 27, 888; **00**, 25, 923; **01**, 26; **02**, 26; **03**, 9; **04**, 5, 10; **05**, 5; **06**, 5; **07**, 5, 9; **08**, 9, 14; **09**, 15; **10**, 12, 16; **11**, 8, 13; **12**, 7, 12.

Part 4, FSP. Boards of Engineers.

1882. Constituted to consider and report upon the condition of fortifications, and what number if any, could be dispensed with. **82**, 423.

Part 5, FSP. Engineers in Charge.

Maj. W. McFarland, 1866–68.
Col. J. H. Simpson, 1868–69.
Lt. Col. C. E. Blunt, 1869–74.
Lt. J. B. Quinn, 1870.
Col. Q. A. Gillmore, 1871–84.
Maj. J. A. Smith, 1874–77.
Capt. W. H. Heuer, 1877–84.
Capt. J. C. Post, 1883.
Capt. T. Turtle, 1884–85.
Capt. W. T. Rossell, 1885–86.
Capt. W. M. Black, 1886–92.
Maj. J. C. Mallery, 1892.
Maj. T. H. Handbury, 1896.
Lt. Col. W. H. H. Benyaurd, 1896–98.
Capt. C. H. McKinstry, 1898–1901.
Capt. T. H. Rees, 1900–02.
Lt. Edmund M. Rhett, 1902.
Capt. H. Deakyne, 1902.

Part 6, FSP. Assistants.

Lt. D. D. B. Gaillard, 1891–92.
Lt. J. J. Meyler, 1896–97.
Lt. R. P. Johnson, 1897–99.
Capt. W. W. Harts, 1898–99.
Lt. E. M. Markham, 1899–1901.
Lt. E. M. Rhett, 1901.

Part 7, FSP—

FORTS AND BATTERIES.

Part 8, FSP. St. Johns River, Fla.—Temporary Battery.

1898. $13,160 allotted. Consent of owners of land obtained; work begun in April on a temporary battery to mount 5-inch B. L. siege rifles and 7-inch B. L. siege howitzers; built of 10 by 10 inch timber in revet., and magazine walls with sand embankment. Two magazines in traverses provided. Gun and howitzers received and mounted in May. **98**, 716.

1899. $100 allotted. Work completed. **99**, 888.

Part 9, FSP. St. Johns River, Fla.—Emplacements for Two 8-inch B. L. Rifles on Strengthened 15-inch Barbette Carriages.

1898. $20,000 allotted. Consent obtained from owners of the land. Work begun, excavation completed, and foundations for the platforms prepared. **98, 713.**

1899. $3,500 allotted. Concrete work begun, platforms completed, carriage altered, and guns mounted. **99, 889.**

Part 10, FSP. East Coast of Florida—Fort Marion.

1756. Fort essentially completed. First named Fort San Augustine; later, Fort St. Mark; built by the Spaniards. Its constr. extended through a period of more than 100 years. **77, 20.**

1873. Repair of brs. and arch of a large vault. **73, 19.**

1875. Fort repaired and certain Indian prisoners or hostages placed in it. **75, 23.**

1876. Repair of fort continued. **76, 24.**

1877. History of fort; built of coquina—a natural shell-concrete found in the vicinity. **77, 20.**

1878. Modification proj. still under consideration. **78, 23.**

1883. Repairs made so that French officers could occupy the fort for the purpose of observing the transit of Venus. **83, 40.**

1884. $5,000 app. **84, 45.**

1885. Picket fence built around reservation. **85, 38.**

1886. Repair of sea wall and breast-height wall; bastion towers renewed, interior wall refaced, ramp rebuilt; minor repairs. **86, 38.**

1891. $15,000 app. 342.5′ of sea wall built, terreplein paved and drained, communications restored and renewed, ditch cleaned and graded, glacis planes restored; minor work. **91, 11, 533.**

1892. Entire terreplein coated with paraffin and petroleum, 260′ of covered drain laid, pavement releveled, and trees planted. **92, 15.**

1899. $200 allotted for minor repairs. Fort converted into a military prison in July, 1898. Some repairs made by the Quartermaster's Department. **99, 888.**

1900. Shrubbery cut down and removed and repair of masonry work of the "City Gates." **00, 923.**

Part 11, FSP. St. Francis Barracks.

1897. $365 allotted for placing platform of one 8-inch converted rifle, mounted for target practice; work completed. **97, 702.**

1898. Eight-inch rifle dismounted and moved to a temporary battery. **98, 716.**

Part 12, FSP. St. Augustine, Fla.—Temporary Battery.

1898. $12,460 allotted. Proj. approv. for timber revet. walls and sand embankment, with 2 magazines in traverses, also built of timber and covered with sand. **98, 717.**

1899. Battery completed and turned over to troops. **99, 888.**

Part 13, FSP. Miami, Fla.—Temporary Battery.

1898. $12,640 allotted. Consent obtained from owners of the land; work begun April 13, and by May 12 the battery was practically completed. **98, 717.**

1899. $470 allotted. Armament and all other property removed and the battery abandoned. **99, 890.**

Part 14, FSP. Key West, Fla.—Fort Taylor and Batteries.

1844. Main work begun. **80, 45.**

1866. Repair of work damaged by hurricane of Oct. 22, 1865. Wrecks removed, break'rs rebuilt and adjusted, 2 new ones built, sea wall repaired, etc.; flagging laid in most of the casemates of the advanced batteries of towers 1 and 2; minor work. **66, 15.**

1867. Work on sea walls, glacis of tower 1; minor work. **67, 13.**

1868. S. end of covered face filled in with sand. Work on sea wall, ditch, and embankment. **68, 17.**

1870. Modification plans being prepared. Pintles placed on barbette tier. **70, 24.**

1871. Modification plans approv.—imp. of main work; completion of the advanced towers; constr. of 2 exterior barbette batteries for heavy guns with magazine traverses. Necessary repair of buildings. **71, 21.**

1872. $42,500 app. Modification work begun, scarp wall of 4 magazines strengthened, barbette tier modified by removal of 18 platforms for 10-inch guns, and placing two 15-inch gun platforms and 3 sand traverses; work on embankments; casemate foundations for platforms and the platforms themselves laid; minor work. **72, 18.**

1873. $50,000 app. S. end of n. battery completed and two 15-inch guns mounted. Work on salient and adjoining faces. Breast-height wall for 4 guns built and minor work. Summary of work. **73, 20.**

1874. $20,000 app. Work on sea walls. Sand embankment and parapet; minor work. **74, 23.**

1875. $15,000 app. 587 c. y. masonry sea wall built and 11,574 c. y. sand embanked in s. battery. Six large masonry shot beds built in rear of casemate. Buildings repaired and minor work. **75, 23.**

1876. Sea wall repaired and minor repairs of the works damaged by hurricane of 1875. Summary of work. **76, 24.**

1877. General repairs, care, and preservation. **77, 20; 78, 23; 79, 27; 80, 45.**

1881. Br. 720′ long, connecting the islds. of Key West with the fort, completed, and care and preservation. **81, 45.**

1885. Cisterns, drains, and buildings cleaned and repaired; minor work. **85, 38.**

1886. Five brick ventilators built, cisterns and buildings repaired, 3 brs. built over road crossings; minor work. **86, 39.**

Part 15, FSP. Key West, Fla.—Emplacements for Two 12-inch B. L. Rifles on Barbette Carriages.

1898. $40,000 allotted. Removing part of old fort. **98, 724.**

1899. $73,000 allotted. 9,166 c. y. of concrete composed of broken brick instead of broken st., and a number of 30-pounder, 100-pounder, and 300-pounder Parrotts, 8-inch columbiads, and 10-inch Rodmans (part of armament of old fort) embedded in the concrete to serve the same purposes as pieces of random st. Two guns and carriages received and base rings set. **99, 892.**

1900. Trolley beams placed, doors hung, and battery turned over to the care of troops on Feb. 3, 1900. Guns and carriages on hand, to be mounted by the troops. **00, 926.**

Part 16, FSP. Key West, Fla.—Emplacements for Four 10-inch Guns on Disappearing Carriages, Model 1896; Two 8-inch Guns on Disappearing Carriages, Model 1894, and Eight 12-inch Rifled Mortars.

1897. $412,225 allotted. Work begun, under contract, on excavation. Description of plant. **97, 703.**

1898. $6,000 allotted. Concrete work completed, ironwork nearly completed (itemized quantity of work to date). $9,300 allotted for moving and mounting guns and carriages. Three 10-inch and two 8-inch guns and carriages and 6 mortar carriages mounted. **98, 721, 722.**

1899. $4,000 allotted for work on emplacement and $900 allotted for moving and mounting guns and carriages. One 10-inch gun and carriage, 2 mortar carriages, and 8 mortars mounted, completing the mounting of armament. Some concrete work, ironwork, and sand filling to be done. Items of work accepted and paid for to Jan. 30, 1899. **99, 891, 896.**

1900. Ironwork completed. Some concrete work and sand filling to be done. Electrical firing apparatus installed in mortar battery. $575 allotted for purchase and installing 12 locking devices for ammunition hoists. Work done by hired labor. $1,800 allotted for providing communicating galleries between emplacements. Plans prepared. Work delayed because of yellow fever. **00, 925.**

1901. New bid for completing work and contract awarded; small amount of sand fill in roadway; necessary plant installed; galleries completed. **01, 826, 827.**

1902. Two of the three storehouses completed; work on gun battery practically completed. **02, 730.** Repair of leaks. **02, 730.** Completion of rear communications of 8-inch and 10-inch batteries. **02, 730.**

Part 17, FSP. Key West, Fla.—Emplacements for Two 4.7-inch R. F. Guns.

1898. $10,000 allotted. Two temporary platforms built and guns mounted. Work begun on permanent emplacements. **98,** 724.

1899. $8,000 allotted. Work on permanent emplacements begun. 1,415 c. y. concrete, composed of broken brick instead of broken st., and 3,478 c. y. sand placed. Emplacement completed. Itemized cost of work. **99,** 894.

1900. Emplacements turned over to troops. **00,** 926.

Part 18, FSP. Key West, Fla.—Four Emplacements for 15-pounder R. F. Guns.

1899. $22,000 allotted. Two emplacements completed, awaiting arrival of gun carriages. 850 c. y. concrete, composed of broken brick instead of broken st., and 2,050 c. y. sand placed. On the other 2 emplacements work was delayed somewhat, only 506 c. y. concrete, similar to that above, placed. **99,** 894.

1900. $750 allotted. 627 c. y. of concrete placed No further work can be done until receipt of the gun mounts. **00,** 926.

1901. Guns mounted and emplacements completed; turned over to artillery Apr. 23, 1901. **01,** 827.

Part 19, FSP. Key West, Fla.—Two Emplacements for 15-pounder R. F. Guns.

1900. $13,000 allotted. Plans approv.; no work. **00,** 927.

1901. Proj. modified to provide for 1 emplacement only, and $6,000 withdrawn; emplacement completed and gun mounted; turned over to Artillery Apr. 23, 1901. **01,** 828.

Part 20, FSP. Key West, Fla.—Emplacements for Right Flank 15-pounder R. F. Gun.

1901. $9,900 allotted. Work begun April, 1901; emplacement nearly completed and ready for base casting of gun mount. **01,** 828.

1902. Work completed. **02,** 731.

Part 21, FSP. Dry Tortugas, Fla.—Fort Jefferson, Garden Key.

1846. Work begun. **80,** 46.

1866. Quarters repaired; walls of large detached magazine raised 13½′ and of small magazine 7½′; 80,000 c. f. of sand removed from ditch and embanked; minor work. **66,** 15.

1867. Quarters nearly completed; 16 barbette platforms received with the new pattern pintle. **67,** 13.

1868. Quarters, except roofing with galvanized iron, completed; ditch on face 3 excavated. **68,** 17.

1869. Work on officers' quarters and soldiers' barracks; excavating sand in ditch; minor work. **69,** 17.

1870. Modified plans being prepared; work on quarters; twenty 4-inch pintles set on barbette tier and all heavy modern guns on hand, with barbette carriages, mounted. **70,** 24.

1871. $42,500 app. **71,** 21.

1872. $42,500 app. Work on sea wall and ditch; modified plans approv. and work begun; 4 curtain magazines strengthened; 8 barbette magazines modified; six 15-inch gun platforms begun and completed and 3 center-pintle masonry platforms for 300-pounder Parrott guns built. **72,** 19.

1873. $50,000 app. Sea wall around fort completed, circulation of ditch fully restored; masonry modification of barbette traverses finished, and balconies in their rear made serviceable; six 15-inch guns and three 300-pounder Parrott guns mounted. **73,** 20.

1874. Repairs of works damaged by hurricane in October; work on embankment and quarters. **74,** 24.

1875. Four-inch pintles placed in 8 platforms; care and preservation. **75,** 24.

1876–84. Care and preservation **76,** 25; **77,** 20; **78,** 23; **79,** 27; **80,** 46; **81,** 46; **82,** 44; **83,** 41; **84,** 45.

1885. Repair of sewers and quarters. **85,** 39.

1886. Building walks, painting casemates, buildings, etc. **86,** 39.

Part 22, FSP. New Fort at Tortugas, Fla.

1866. Plans to be considered by the BE. **66,** 15.

1867. Best combination of materials for uncovered scarps not decided. **67,** 13; **68,** 17.

1869. Commencement to be deferred till a suitable proj. for the position be prepared. **69,** 17.

Part 23, FSP. Miscellaneous.

Electric light plant—Key West, Fla.—**1899.** $18,500 allotted. Work begun on 2 power stations and 2 separate light plants; stations completed, 1 dynamo installed, and wiring in progress. **99,** 895.

1900. $800 allotted. Work completed and turned over to the care of troops on Mar. 12, 1900. **00,** 927.

Pumping plant for mortar battery. **1902.** To prevent accumulation of waters in mortar pits, pumping plant installed. **02,** 730.

Civilian electricians. **1902.** $1,200 allotted for pay. **02,** 732.

Part 24, FSP. Preservation and Repair.

1897. Key West—$2,701.12 allotted. Repair of quarters and brs. **97,** 707.

1898. Key West—$5,950 allotted. Repair of brs., buildings, and 2 temporary platforms for 15-inch guns built of timber and concrete; and guns mounted. Two unserviceable platforms at north battery torn out and guns, still mounted on carriages, moved to the rear. Three platforms of concrete and granite pintle blocks, for 8-inch converted rifles, built on site of the old platforms, and guns mounted. **98,** 724.

1899. Fort Marion, Fla.—$200 allotted for minor repairs. **99,** 888. St. Johns River—$2,350 allotted for care of torpedo material, RR. track, and care of property. **99,** 889. $875 allotted for repair of leaks in gun and mortar batteries; methods and results of waterproofing. **99,** 896. $3,000 allotted for a roadway. Work on sand fill. **99,** 897. $700 allotted for repairs to brs. and buildings. $400 allotted for storage of torpedo material; work completed. **99,** 897.

1900. St. Johns River—$1,700 allotted for cleaning and storing torpedo material and for watchman's services. **00,** 923. Roadway—1,000 c. y. of brick crushed and 250 blocks of concrete curbing, each 4′ long, made; necessary fill incomplete. **00,** 927. $100 allotted for supplies for care and preservation of electric-light plant; supplies purchased and turned over to the care of troops. **00,** 929.

1901. Fort Marion, Fla.—locks for casemate doors. **01,** 826. St. Johns R., Fla.—$1,020 allotted. Torpedo material overhauled, cleaned, and stored away. **01,** 826. Key West, Fla.—$2,305 allotted for misc. repairs. **01,** 828.

1902. Fort Marion—plastering walls and ceiling of casemate 4. **02,** 729. St. Johns R.—inspection mining material. **02,** 729. Key West—repairs, necessary painting, inspections, etc. **02,** 732.

Part 25, FSP. Range and Position Finders.

1899. Key West—$20 allotted. Five-inch cast-iron pipes filled with cement were set up as stations for Lewis depression range finders, emergency (B) type. Base rings for the instruments set in mortar on top of these pipes. **99,** 896.

1901. $9,850 allotted for battery-commander's station; no work done and contract voided. **01,** 828.

1902. Station completed and turned over, **02,** 732. $2,200 allotted for observation stations, mortar battery; work practically completed. **02.** 730, 731.

Part 26, FSP. Sites.

Key West—$4,600 allotted and 1 site, Livermore estate, bought. $100 allotted for incidental expenses connected with acquirement of another site for which condemnation proceedings were instituted. **97,** 707. $19,800 allotted, and site, for which proceeding had been instituted, purchased. **98,** 723.

East coast of Florida—$250 allotted for survey of site needed for fortification purposes. **99,** 890. $1,500 allotted for making a topographical survey; completed. **00,** 924.

Proceedings in progress for acquisition of 117.7 acres land. **01,** 826.

1902. Deed for 117.7 acres received, June 5, 1902; allotment of $50 made. **02,** 729.

Part 27, FSP. Submarine Mines.

1897. Key West, Fla.—$10,000 allotted for mining casemate and cable gallery. Proj. Work begun and the cable gallery completed. Table showing results of Rosendale cement tests. **97,** 705.

1898. St. Johns R., Fla.—$8,000 allotted for planting mines, material purchased, and mines made ready for planting. **98,** 720. Key West—$22,000 allotteor purchasing material and planting mines and operating a 30-inch searchlight. Mines planted and searchlight operated nightly. **98,** 726.

1899. St. Johns R., Fla.—mines removed in September, 1898, by exploding them; cable and other material stored. 1,800 pounds of unused dynamite sold for $216 to the dealer who furnished it. **99,** 889. Key West—$4,800 allotted for a cable tank, with RR. track leading to break'r; work about completed. $200 allotted for fitting up casemates for the storage of torpedo material; not completed. **99,** 895. $682 allotted for operating searchlights: as all mines were removed by explosion, the money was not used. **99,** 897.

1900. $3,105 allotted for general repair of plant, painting ironwork, etc., and caring for torpedo material. **00,** 928.

Part 28, FSP. Supplies for Coast Defenses.

1900. $800 allotted for such supplies as might be called for by requisition of the Artillery; duly approv. by the Chief of Engineers. **00,** 929.

1901. Key West—three shelters for hygrometers and thermometers purchased and set up. **01,** 829.

1902. Supplies purchased and issued. **02,** 733.

FGP. WESTERN FLORIDA FORTIFICATIONS.

(NOTE.—Reports on these works from 1903 to 1912 are of a general character only. See the first 15 pages of each annual report from 1903 to 1912.)

Part.	Title.	Period.
	(See Nos. 1–28 on p. 1955 of this Index.)	
29	Contracts	1899
30	Engineering features	....
31	Engineers—Chief of Engineers	1898–1912
32	In charge	1898–1902
33	Assistants	1898–1902
34	Forts, etc. (allotments, operations, etc.)	1898–1912
35	Tampa, Fla.—Temporary batteries	1898–1899
36	Emplacements for two 8-inch B. L. rifles on strengthened 15-inch barbette carriages	1898–1899
37	Emplacements, two 6-inch R. F. guns	1898–1899
38	Emplacements, eight 12-inch mortars	1899–1901
39	Two emplacements, 8-inch guns, disappearing carriages	1899–1900
40	Emplacements, three 15-pounder R. F. guns	1901–1902
41	Emplacement, one 15-pounder R. F. gun	1901–1902
42	Emplacements, two 15-pounder R. F. guns	1901–1902
43	Miscellaneous (electrician)	1902
44	Preservation and repair	1900–1902
45	Sea walls and embankments	1902
46	Submarine mines	1898–1900
47	Supplies	1901–1902

Part 29, FGP. Contracts.

1899. Portland cement, $2.75 per barrel. Random and crushed st., $2.66 per c. y. **99,** 911.

Part 30, FGP. Engineering Features.

Anchor plates, method of supporting. **99,** 902; **00,** 935.

Cable tank, description and cost **99,** 904.

Concrete, cost per c. y. **99,** 908, 911; **00,** 932, 935. Description of. **99,** 902. Mixing. **99,** 606.

Guns, repair of anchorage. **02,** 2466.

Linings, to make dry magazines **02,** 2466.

Plant, electric-light. **00,** 931, 932, 934, 937.

Materials and labor, itemized cost of. **00,** 932, 933, 935.

Materials, quantities. **99,** 900; **00,** 930.

Part 31, FGP. Engineers.

Chief of Engineers. **R., 98,** 718; **99,** 29, 899; **00,** 26, 929; **01,** 27; **02,** 28.

(See Part 3, FSP.).

Part 32, FGP. Engineers in Charge.

Lt. Col. W. H. H. Benyaurd, 1898–99.
Capt. H. Jervey, 1899–1900.
Capt. T. H. Rees, 1900–02.
Lt. E. M. Rhett, 1902.
Capt. H. Deakyne, 1902.

Part 33, FGP. Assistants.

Lt. R. P. Johnston, 1898–99.
Capt. W. W. Harts, 1898–99.
Lt. E. M. Markham, 1899.
Lt. F. Boggs, jr., 1899–1900.
Lt. E. M. Rhett, 1901–02.

Part 34, FGP—

FORTS AND BATTERIES.

Part 35, FGP. Temporary Batteries.

1898. $14,900 allotted. Work begun April 26; both completed by June 30, constr. of timber and sand; guns and howitzers mounted in position June 1. **98, 718.**

1899. One 5-inch gun dismounted and turned over to Gen. Rodgers, U. S. V. In January, 1899, work turned over to the troops. **99, 899.**

Part 36, FGP. Emplacements for Two 8-inch B. L. Rifles on Strengthened 15-inch Barbette Carriages.

1898. $29,500 allotted. Plans approv. and material ordered. **98, 719.**

1899. $4,000 allotted. Work begun in July, 1898, and completed in December, 1898, and guns mounted. Battery turned over to the troops. Entire cost, $32,503.04. Description of work done **99, 899.**

1900. Guns dismounted and mounted on disappearing carriages at Battery McIntosh. **00, 933.**

Part 37, FGP. Emplacement for Two 6-inch R. F. Guns.

1898. $29,600 allotted. Plans approv. and material purchased. **98, 719.**

1899. $5,000 allotted. Work begun in July and completed December, 1898. Guns mounted and battery turned over to the troops. Ammunition service provided. Description of work. **99, 900.**

Part 38, FGP. Emplacement for Eight 12-inch Mortars.

1899. $150,000 allotted. Work begun: dock built; all gun beds completed and anchor bolts set. Two mortar carriages received. Description and cost of work to date. **99, 905.**

1900. $5,651.96 allotted. All emplacements completed; 8 carriages mounted and battery turned over to the Artillery command. Electric-light plant installed; description of plant. Itemized cost of labor and materials. Summary o work. **00, 930.**

1901. $1,100 allotted for clearing up ground useless buildings torn down. **01, 830.**

Part 39, FGP. Two Emplacements for 8-inch Guns on Disappearing Carriages.

1899. $97,500 allotted. Work begun: dock built necessary buildings erected; 1,518 c. y. concrete placed; shell used in concrete masonry. Description of work, with tracing showing arrangement of plant. **99, 908.**

1900. $21,449.53 allotted. Battery completed and turned over to the Artillery command; one 8-inch carriage received and mounted and the other carriage received and turned over to the troops for mounting. Electric-light plant installed. Description. Details of work, with cost. **00, 933.**

Part 40, FGP. Emplacements for Three 15-pounder R. F. Guns.

1901. $15,000 allotted. Emplacements completed with exception of gun platforms; details of work given. **01, 830.**

1902. $440 allotted. Emplacements and platforms completed. **02, 734.**

Part 41, FGP. Emplacement for One 15-pounder R. F. Gun.

1901. $8,400 allotted. Line for railway graded; repairs to plant; preparation for constr. made 01, 830.

1902. $1,800 allotted. Constr. completed except mounts. 02, 733.

Part 42, FGP. Emplacements for Two 15-pounder R. F. Guns.

1901. $17,100 allotted. Plant erected; preparations for commencing work made. 01, 831.

1902. Work completed except mounts. 02, 733.

Part 43, FGP. Miscellaneous.

1902. $750 allotted for pay of electrician. 02, 735.

Part 44, FGP. Preservation and Repair.

1900. $1,227 allotted for inspecting, cleaning, moving, and protecting submarine mine material and repairing dock. All the work completed. 00, 936.

1901. $375 allotted. Leaks in ceiling of dynamo room repaired. 01, 831. $15 allotted for boxes to store electrical instruments; mining material overhauled and cleaned. 01, 832.

1902. Stopping leaks, placing sills in doorways, and erecting pedestal for Rafferty range finder. 02, 734.

Part 45, FGP. Sea Walls and Embankments.

1902. $2,400 allotted for building concrete wall to prevent erosion in front of 6-inch battery. 02, 734.

Part 46, FGP. Submarine Mines.

1898. $16,300 allotted for purchase of explosives, laying mines, and patrolling mine fields. No mines planted. 98, 720.

1899. $4 allotted. Storage shed built and materials stored. Two t. dynamite, purchased when orders for planting mines were first received, burned. 99, 903. $5,725 allotted for cable tank, which was completed except the traveling crane. Description of tank, with cost. 99, 904.

1900. Cable tank traveling crane installed. 00, 929. All material inspected, cleaned, and stored. 00, 936.

Part 47, FGP. Supplies for Seacoast Defenses.

1901. Shelters for hygrometers and thermometers purchased and turned over to post commander. 01, 831.

1902. Requisitions filled. 02, 735.

FGQ. ALABAMA-FLORIDA FORTIFICATIONS.

(NOTE.—Reports on these works from 1903 to 1912 are of a general character only. See the first 15 pages of each annual report from 1903 to 1912.)

Part.	Title.	Period.
1	Contracts	1898–1899
2	Engineering features	....
3	Engineers—Chief of Engineers	1866–1912
4	B E	1882
5	In charge	1866–1902
6	Assistants	1895–1901
7	Forts, etc. (allotments, operations, etc.)	1828–1912
8	Pensacola, Fla.—Fort Pickens	1828–1880
9	Fort McRee	1836–1880
10	Fort Barrancas and redoubt	1839–1886
11	Battery, four 10-inch guns	1895–1902
12	Mortar battery, eight 12-inch mortars	1898–1902
13	Battery two 4.7-inch R. F. guns	1898–1899
14	Battery, two 12-inch guns, disappearing carriages	1898–1900
15	Battery, two 8-inch guns, disappearing carriages	1898–1902
16	Battery, four 15-pounder R. F. guns	1899–1901
17	Miscellaneous (magazine doors; electric wiring; transporting plant)	1901–1902
18	Preservation and repair	1897–1902
19	Range and position finders	1899–1902
20	Sea walls	1882
21	Submarine mines	1894–1900
22	Supplies	1901–1902

Part 1, FGQ. Contracts.

1898. Natural cement, 95¢ per barrel. Electric plant for mortar battery, $6,474. **98,** 7 30.

1899. Gravel, $1.70 per c. y. Natural cement, $1.55 per barrel. Portland cement, $2.25 and $2.55 per barrel. Gravel, $2.20 per c. y. **99,** 915, 916.

Part 2, FGQ. Engineering Features.

Bins, storage; description and cost. **97,** 716.

Concrete, cost per c. y. in place **97,** 719; **98,** 727; **99,** 919.

Dampproofing, methods. **04,** 3726.

Derrick system, description. **99,** 920.

Forms, concrete; cost. **97,** 717.

Labor, distribution and itemized cost. **98,** 733; **99,** 919.

Materials, description, with quantities and itemized cost. **98,** 726, 733; **99,** 915, 916, 917, 920.

Mixer, description and cost **97,** 716.

Plant, cost. **97,** 718.

Plant, description of. **98,** 726; **99,** 920.

RR., 3′ gauge; description and itemized cost. **97,** 715.

Walls, cement, coloring. **04,** 3727.

Waterproofing, method of. **98,** 727; **99,** 916, 922; **00,** 940, 941, 942; **04,** 3726.

Water supply, cost. **97,** 717.

Wharf, description of, and itemized cost. **97,** 715.

Part 3, FGQ. Engineers.

Chief of Engineers. **R.,** **66,** 15; **67,** 13; **68,** 17; **69,** 17; **70,** 25; **71,** 21; **72,** 19; **73,** 20; **74,** 24; **75,** 24; **76,** 25; **77,** 20; **78,** 24; **79,** 28; **80,** 46; **81,** 46; **82,** 44; **83,** 41; **84,** 46; **85,** 39; **86,** 40; **94,** 10; **95,** 11; **96,** 18, 518; **97,** 18, 714; **98,** 27, 725; **99,** 30, 914; **00,** 26, 939; **01,** 27; **02,** 28; **03,** 9; **04,** 10; **05,** 5; **06,** 5; **07,** 5, 9; **08,** 9, 14; **09,** 15; **10,** 12, 16; **11,** 8, 13; **12,** 7, 12.

Part 4, FGQ. Board of Engineers.

Constituted, 1882, to consider and report upon the condition of fortifications, and what number, if any, could be dispensed with. 82, 425.

Part 5, FGQ. Engineers in Charge.

Capt. J. C. Palfrey, 1866.
Capt W. E. Merrill, 1866.
Maj. M. C. McAlester, 1866–68.
Maj. F. E. Prime, 1868–69.
Capt. A. N. Damrell, 1869–70.
Maj. C. B. Reese, 1871.
Col. J. H. Simpson, 1871-73.
Lt. Col W. F. Reynolds, 1873.
Maj. A. N. Damrell, 1873–85.
Capt. R. L. Hoxie, 1885–86.
Capt. P. M. Price, 1894.
Maj. F. A. Mahan, 1894–99.
Capt. C. A. F. Flagler, 1899-1901.
Capt. W. V. Judson, 1901-02.
Lt. R. R. Raymond, 1902.

Part 6, FGQ. Assistants.

Lt. C. Keller, 1895.
Lt. C. P Echols, 1895–93
Lt. J. P. Jervey, 1896–99. R., 97, 714.
Lt. L. H. Rand, 1899-1901.
Lt. G. R. Lukesh, 1901.

Part 7, FGQ—

FORTS AND BATTERIES.

Part 8, FGQ. Fort Pickens.

1828. Work begun. **80,** 46.

1866. One front pintle barbette gun platform for modern armament and 1 for projectile built; repairs and modifications of the parapet of w. bastion. **66,** 15.

1868. Wharf rebuilt; drains, road, and pavement of terreplein repaired; removing sand and traverses in s. bastion and uncovering casemate arches of sw. bastion for foundation of 15-inch gun platform. **68,** 17.

1869. Road completed; gun platform in w. bastion prepared and gun mounted; work on platform for a large gun in sw. bastion; wooden platforms for projectiles built; general repairs and minor work. **69,** 17.

1870. Modification plans being prepared. **70,** 25.

1871. General repairs of wharf, storehouses, etc. **71,** 21.

1872. Magazine doors repaired. **72,** 19.

1873. Care and preservation. **73,** 20.

1874. Repair of cisterns, magazine doors, and buildings; four 4-inch front pintle masonry platforms with low traverse sts. and 2 of the same with high traverse sts. built for ordnance on hand, and 2 more with low traverse sts. nearly completed; minor work. **74,** 24.

1875. $25,000 app. **75,** 24.

1876. Necessary buildings repaired and new ones built; RR. track laid; cars and derricks made; modifications of bastion C nearly completed, and work begun on bastion D. **76,** 25.

1877. Bastion D completed; repairs to terreplein, stairs, bermes, etc. **77,** 20.

1878. Repair of wharf and buildings. **78,** 24; **79,** 28.

1880. History of fort; care and preservation. **80,** 46; **83,** 41; **86,** 40.

Part 9, FGQ. Fort McRee.

1836. Work begun. 80, 47.

1873. Care and preservation. 73, 20.

1874. Site undermined by action of sea; scarp fallen, leaving casemates open. Modification plans for barbette batteries for heavy guns and a mortar battery to take the place of the old work. 74, 25.

1875. Modification plans approv. for 4 batteries for heavy guns, and 1 mortar battery. 75, 24.

1878. All property of value transferred to Fort Pickens. 78, 24.

1880. History of fort. 80, 47.

Part 10, FGQ. Fort Barrancas and Redoubt, Including the Old Spanish Fort.

1839. Work begun. 80, 46.

1866. Condition of work. 66, 15.

1868. Breast-height walls of the main work and of the redoubt repaired and parapets regraded and sodded; necessary repairs of foundation of sw. angle of counterscarp wall; s. extremity of glacis and ditch graded and sodded; gates made and hung, and work on fence around reservation begun. 68, 17.

1869. Fence around work completed; brs. repaired; grating and ventilators placed in magazines; and minor work. 69, 17.

1870. Modification plans being prepared. 70, 21.

1873. Magazine doors built. 73, 20.

1874. Preparations for constr. platforms in progress. 74, 25.

1875–78. Care and preservation. 75, 24; 76, 26; 77, 21; 78, 24.

1880. History of fort. 80, 46.

1881–82. Work on fence around fort and redoubt. 81, 47; 82, 46.

1883–86. Care and preservation. 83, 41; 84, 47; 85, 40; 86, 40.

Part 11, FGQ. Battery for Four 10-inch Guns.

1895. $100,000 allotted. Survey made. 95, 11.

1896. $60,000 allotted. Work begun, wharf built, and constr. plant in progress. Description of wharf. 96, 518.

1897. $31,500 allotted. Concreting begun Nov. 1, 1896, and completed Mar. 29, 1897. Sand filling completed. Battery practically completed, ready for armament. Summary of work with itemized cost. 97, 714.

1898. Electric-light plant installed, 4 guns and carriages mounted, and battery turned over to the troops. Itemized cost of work. 98, 726.

1899. Road built along rear of battery. 99, 914.

1900. $2,300 allotted for imp. the cramped condition of the electric-light plant, involving the constr. of 2 addl. rooms, removing the sand covering, and imp. the ventilation. Work begun. 00, 939.

1901. Work on extension of room completed; 2 new chambers built, 1 for generator and 1 for storage battery, leaving old room for boiler. 01, 832. $1,600 allotted for connecting 4 loading platforms by means of concrete-steel gallery. 01, 833.

1902. Work on gallery completed. 02, 735.

Part 12, FGQ. Mortar Battery for Eight 12-inch Mortars.

1898. $121,000 allotted. Work begun in August, 1897. Concrete work begun in February and completed on May 31, 1898. 9,700 c. y. placed. Description of constr. plant, materials, and actual work, with itemized cost. Three carriages in position. 98, 726.

1899. $2,250 allotted. Battery completed: mortar carriages mounted. 12,000 c. y. sand filling placed; electric-light plant installed; 2 observation stations, with stairways of concrete and steel, built. Completed battery turned over to the Artillery June 30, 1899. 99, 914.

1900. The 8 mortars received mounted by the Artillery. 00, 939.

1901. $500 allotted for gathering up and storing part of plant used in constr. and for building boathouse for naphtha launch; work nearly completed. 01, 833. $600 allotted for remedying dampness in magazine No. 1; floor raised and building interior detached ceiling and walls of lead and brick. 01, 834.

1902. All work completed. 02, 736. $30 allotted for placing guide rails upon loading platforms. 02, 736.

Part 13, FGQ. Battery for Two 4.7-inch R. F. Guns.

1898. $6,000 allotted. Work begun; concrete mixed by hand and placed with wheelbarrows. Battery completed and guns mounted. Description of work with itemized cost. **98,** 732.

1899. Some sand filling placed; hanging doors and building a chert road in rear. Battery turned over to the Artillery in October, 1898. **99,** 918.

Part 14, FGQ. Battery for Two 12-inch Guns on Disappearing Carriages.

1898. $50,600 allotted. Concrete in 1 emplacement completed and in second emplacement platform and foundations finished. Summary of work with cost. **98,** 732.

1899. $28,865 allotted. 13,770 c. y. sand filling placed, completing same, and a total of 9,400 c. y. concrete placed. Electric-light plant installed; ammunition conveyors, ladders, doors, etc., placed. Guns and carriages received and the work of mounting same begun. Battery turned over to the Artillery June 30, 1899. **99,** 916.

1900. Carriages and guns mounted by the Artillery. **00,** 940.

Part 15, FGQ. Battery for Two 8-inch Guns on Disappearing Carriages.

1898. $199,750 allotted. Work begun, wharf completed, concrete foundation of magazines and passages completed, and all pre. finished. **98,** 735.

1899. $23,824 allotted. Battery completed, carriages mounted, electric plant installed; hand ammunition hoists, trolley ammunition conveyors, and cranes placed. Summary of work with itemized cost. Tracing showing derrick system. **99,** 918.

1900. Guns received and mounted and battery turned over to the Artillery Mar. 21, 1900. **00,** 941.

1901. $1,500 allotted for installation of searchlight; work completed. **01,** 832. $700 allotted for connecting 2 loading platforms of this battery by means of concrete-steel gallery. **01,** 833.

1902. Work on gallery completed. **02,** 736.

Part 16, FGQ. Battery for Four 15-pounder R. F. Guns.

1899. $20,230 allotted. Work begun Mar. 16, 1899. 777 c. y. concrete placed and 3,197 c. y. sand placed for filling. **99,** 915.

1900. $14.58 allotted. Concrete work completed. 1,243 c. y. placed and 5,696 c. y. of sand filling placed, completing same. Magazine roofs asphalted. No armament received. **00,** 940.

1901. $360 allotted. Battery completed and turned over to Artillery Apr. 30, 1901. **01,** 833.

Part 17, FGQ. Miscellaneous.

Doors for magazines. **1901.** $625 allotted for 10-inch and 12-inch batteries; doors hung at magazine No. 1; 12-inch battery and some ironwork for others completed. **01,** 834.

1901 $275 allotted for 8-inch battery; work not yet begun. **01,** 835; **02,** 738.

1902. At 10-inch and 12-inch battery arrangements made for manufacture of remaining doors. **02,** 737.

Electric wiring. **1901.** $2,300 allotted for wiring for a system of exterior and interior wiring. **01,** 834.

1902. Work completed. **02,** 733. $2,000 allotted for rewiring 10-inch and 12-inch batteries. No work done. **02,** 738.

Transporting plant. **1902.** $251.97 allotted for returning to Coosa R. works plant borrowed therefrom. **02,** 737.

Part 18, FGQ. Preservation and Repair.

1897. $1,820 allotted. Three concrete platforms with granite pintle blocks for 8-inch converted rifles built to replace 3 timber platforms, which were rotten. Ammunition conveyors repainted. **97,** 721.

1898. $2,225 allotted for repair of old works; 2 casemates and officers' quarters repaired; loading platforms of 15-inch S. B. guns renewed; 2 shot beds made; the old Spanish fort thoroughly overhauled and restored as far as possible. **98,** 736.

1899. $10,143 allotted. Magazines of 10-inch battery asphalted; minor repair of old forts and slopes of new works. **99,** 922.

1900. $4,910 allotted. Repair of wharf, slopes, magazine doors. Waterproofing magazines and dynamo room; mounting guns; repairs of breast-height wall at Fort Barrancas, and minor work. **00,** 941.

1901. $7,465 allotted for shore protection 15-pounder battery; repairs to slopes; care of torpedo material; care and repairs to plant. **01,** 835.

1902. $4,670 allotted. Repairs to 12-inch mortars, 10-inch, 8-inch, 4.7-inch, and 3-inch batteries. **02,** 738.

Part 19, FGQ. Range and Position Finders.

1899. Two observation stations built. **99,** 914.

1901. $140 allotted for shelter for position finder; work completed. **01,** 834. $150 allotted for fire-commander's station. **01,** 834.

1902. Work on fire-commander's station held in abeyance pending decision as to change of dimensions. **02,** 736. $18,118.60 allotted. Eight bases for Rafferty range finders placed upon the different batteries; shelters constr. **02,** 737.

Part 20, FGQ. Sea Walls and Embankments—Fort McRee.

Work on jetty in front of fort. **82,** 45.

Part 21, FGQ. Submarine Mines.

1894. One mining casemate completed; cost, $8,012.39. **94,** 10.

1899. $9,000 allotted. Mines planted and removed by exploding them; doorway cut through the masonry into the adjoining casemate of a fort and a blower added to imp. ventilation; both casemates ceiled with flooring to prevent dampness. One casemate demolished by explosion June 20; torpedo storehouse built of brick, slate roof, and a traveling crane where nearly all torpedo material was stored, was completely demolished by explosion; a building erected by contractor was bought for $200, repaired, and fitted up as a loading room for submarine mines. This building was demolished by the explosion of June 20. **99,** 922. $1,000 allotted for operating searchlights; materials bought. **99,** 923.

1900. $8,040 allotted. Mining casemate, torpedo storehouse, and cable tank injured by the explosion of June 20, 1899, repaired. One searchlight plant transferred to the Artillery, and the other plant, injured by the explosion of June 20, 1899, repaired. **00,** 943.

Part 22, FGQ. Supplies for Seacoast Defenses.

1901. $600 allotted. Supplies furnished on approval. **01,** 835.

1902. $1,070 allotted. Supplies furnished. **02,** 739. $700 allotted for constr. of offices and storerooms; work completed. **02,** 740. $275 allotted for connecting boiler rooms of 10-inch and 12-inch batteries with post water supply. **02,** 740. $175 allotted for building coal sheds; work completed. **02,** 740.

FGR. ALABAMA-MISSISSIPPI FORTIFICATIONS.

(Note.—Reports on these works from 1903 to 1912 are of a general character only. See the first 15 pages of each annual report from 1903 to 1912.)

Part.	Title.	Period.
1	Contracts	1897–1902
2	Engineering features	
3	Engineers—Chief of Engineers	1866–1912
4	BE	1882
5	In charge	1866–1902
6	Assistants	1895–1901
7	Forts, etc. (allotments, operations, etc.)	1819–1912
8	Mobile Bay, eastern entrance—Fort Morgan	1819–1886
9	Fort Gaines	1848–1886
10	Mobile, Ala.—Site 1—Battery, 8-inch guns	1895–1902
11	Battery, two 12-inch rifles, disappearing carriages	1898–1902
12	Site 2—Battery, two 8-inch rifles, 15-inch Rodman carriages	1898–1899
13	Mississippi coast—Ship Island	1862–1886
14	Site 1—Emplacement, 4.7-inch R. F. gun	1898–1902
15	Mortar battery, eight 12-inch B. L. mortars	1899–1902
16	Emplacements, two 15-pounder R. F. guns	1899–1900
17	Site 2—Emplacements, two 6-inch R. F. guns, disappearing carriages	1899–1902
18	Emplacements, two 15-pounder R. F. guns	1901–1902
19	Miscellaneous (magazine)	1902
20	Preservation and repair	1897–1902
21	Range and position finders	1902
22	Sea walls and embankments	1867–1902
23	Submarine mines	1895–1902
24	Supplies	1900–1902

Part 1, FGR. Contracts.

1897. Sea wall—fascine mattress in place, $1.40 per sq. y.; stone in place, $3.20 per c. y. **97,** 723.

1899. Gravel, 10,000 c. y., $2 per c. y.; Atlas Portland cement, 12,000 barrels, $2.17 per barrel. **99,** 926.

1900. Sea wall—st. in place, $3.25 per c. y.; fascine mattress in place, 75¢ per sq. y. **00,** 949.

1902. Erecting and completing storage magazines, $6,500 allotted. **02,** 745. Roofing storage magazines, $350 allotted. **02,** 745.

Part 2, FGR. Engineering Features.

Air spaces. **00,** 951.
Concrete ingredients. **00,** 944.
Concrete mixing. **98,** 741.
Drainage. **04,** 3727.
Leakage, preventing. **03,** 2414; **04,** 3727.
Linings. **02,** 2467; **03,** 2414 (pl.); **04,** 3727.
Materials, itemized cost. **97,** 726.
Mines, firing by judgment. **98,** 744.
Mixer, concrete. **00,** 950.
Plant, concrete. **99,** 925.
Electric light. **99,** 928; **00,** 944.
Itemized cost. **97,** 726.
Sea wall, description of. **00,** 948.
Waterproofing. **98,** 740; **99,** 924, 928; **00,** 944, 946, 947, 950; **02,** 2467 (pl.).
Waterproofing, asphalt. **04,** 3728.
Waterproofing, tarred paper for. **02,** 2469.

Part 3, FGR. Engineers.

Chief of Engineers. R., 66, 16; **67,** 13; **68,** 18; **69,** 17; **70,** 25; **71,** 21; **72,** 19; **73,** 21; **74,** 25; **75,** 24; **76,** 25; **77,** 21; **78,** 24; **79,** 28; **80,** 47; **81,** 48; **82,** 46; **83,** 42; **84,** 48; **85,** 41; **86,** 41; **95,** 11; **96,** 18, 519; **97,** 18, 722; **98,** 28, 737; **99,** 30, 924; **00,** 27, 943; **01,** 28; **02,** 29; **03,** 9; **04,** 5, 9, 10; **05,** 5, 10; **06,** 5; **07,** 5, 9; **08,** 9, 14; **09,** 10, 15; **10,** 12, 16; **11,** 8, 13; **12,** 7, 12.

Part 4, FGR. Board of Engineers.

Constituted, 1882, to consider and report upon the condition of fortifications, and what number, if any, could be dispensed with. 82, 426.

Part 5, FGR. Engineers in Charge.

Capt. J. C. Palfrey, 1866.
Capt. W. E. Merrill, 1866.
Maj. M. D. McAlester, 1866–68.
Maj. F. E. Prime, 1868–69.
Capt. A. N. Damrell, 1869–70.
Maj. C. B. Reese, 1870–71.
Col. J. H. Simpson, 1871–73.
Lt. Col. W. F. Raynolds, 1873.
Lt. Col. A. N. Damrell, 1873–96.
Lt. E. E. Winslow, 1896.
Maj. W. T. Rossell, 1896–1902. R., 96, 821.
Capt. Spencer Cosby, 1902.

Part 6, FGR. Assistants.

Lt. E. E. Winslow, 1895–96.
Lt. H. Burgess, 1896–97.
Lt. J. B. Cavanaugh, 1897–1900.
Lt. M. L. Walker, 1901.

Part 7, FGR—

FORTS AND BATTERIES.

Part 8, FGR. Eastern Entrance to Mobile Bay—Fort Morgan, Mobile Point, Ala.

1819. Work begun. 80, 47.

1833. Fort completed. 80, 47.

1866. Shot holes in counterscarp repaired and those in the scarp made ready for masonry. 66, 16.

1867. General repairs to parapet, parade walls, and terrepleins of all the front. Work on a break'r. 67, 14.

1868. Repair of buildings, break'r, drains. 68, 18.

1869. Repair of wharf, break'r, and slopes. 69, 17.

1870. Modification plans being prepared. Minor repairs made. 70, 25.

1871. General repairs. 71, 22.

1872. Wharf rebuilt, iron screw piles used instead of wooden ones, and the st., brick, and wood pier leading to it renewed. 72, 19.

1873. Engr. property removed from casemates and stored in buildings outside the fort to make room for ordnance stores and ammunition. Twelve fender piles were coppered and placed around head of wharf; work begun on sea wall. 73, 21.

1874. Work on sea wall, repair of slopes and ditches; ten 4-inch front pintle masonry platforms, with low traverse sts., and 2 of same with high traverse sts. built. Est. cost of proposed modifications for exterior batteries, with positions for 37 guns of the largest caliber, and for emplacements for mortars in the old work, $370,000. 74, 25.

1875. $25,000 app. Slight repairs to sea wall and wharf. 75, 24.

1876. Modification work begun; quarters, buildings, and RR. track repaired. 2,687′ new RR. track and 4 cars built; parados, parapet, breast-height wall and foundation for the gun platform for gun position No. 1, service magazines for the battery, breast-height wall, foundation for gun platform, and part of parapet for gun position No. 2, completed. 76, 25.

1877. General repairs to slopes, drains, etc. Work begun on extension to sea wall. 77, 21.

1878. Sea-wall extension, 750′ long, completed. Repairs to buildings; 2 cisterns, each with a capacity of 7,300 gallons, built. 78, 24.

1879. Repairs to fence, wharf, slopes, and ditches. 79, 28.

1880. History. Work on sea wall. 80, 48; 81, 48; 82, 46; 83, 42.

1886. Shutters fitted to embrasures; ditches, drains, gutters, etc., cleaned. 86, 41.

Part 9, FGR. Entrance to Mobile Bay—Fort Gaines, Dauphin Island.

1848. Work begun. **80,** 48.

1866. Fort in serviceable condition. **66,** 16.

1868. Repairs to wharf, buildings; earth cover of scarp of sw. bastion removed and the material embanked in glacis; 2 wing dams built. **68,** 18.

1869. Repairs to wharf, plank walks, buildings; slopes and ditches graded; 2 jetties and a break'r built. **69,** 17.

1870. Modification plans being prepared. **70,** 25.

1871-72. Care and preservation. **71,** 22 **72,** 19.

1873. Drains cleaned and repaired and work on jetties. **73,** 21.

1874. Work on jetties, 4 front and 4 center pintle platforms removed, and 4 carriages and chassis removed from beach. Est., modifications, $83,000. **74,** 25.

1875. Care and preservation. **75,** 24; **76,** 26.

1877. Repairs to buildings; a brush apron and jetty built. **77,** 21.

1878. Care and preservation. **78,** 24; **79,** 29.

1880-86. History; care and preservation. **80,** 48; **83,** 43; **84,** 48; **85,** 41; **86,** 41.

Part 10, FGR. Mobile, Ala.—Site 1—Battery for 8-inch Guns.

1895. $50,000 allotted. Work begun. **95,** 11.

1896. $9,000 allotted. 6,800 c. y. concrete placed. Itemized cost of work. $5,000 allotted for constr. platform; partly finished. Itemized cost. **96,** 520.

1897. $118,500 allotted. Emplacements 1 and 2 ready for carriages, model of 1894; and emplacements 3 and 4 for carriage, model of 1896. First emplacement completed; partial constr. of the 3 others. Summary and itemized cost of each emplacement and platform. **97,** 724.

1898. $16,500 allotted. All concrete placed; trolley systems and ammunition hoists, etc., installed; all guns and carriages mounted and the battery practically completed and transferred to the Artillery. $14,700 allotted to complete the battery, install the electric plant, and repair and strengthen wharf; work in progress. **98,** 733.

1899. $500 allotted. 3,517 c. y. sand placed in parapet, 4,690 sq. y. sod placed, electric plant installed, magazines waterproofed, and a carpenter shop built. **99,** 924.

1902. $2,000 allotted. Constr. bracket gallery along rear of battery; work practically completed; misc. repairs of care and preservation. **02,** 742.

Part 11, FGR. Mobile, Ala.—Site 1—Battery for Two 12-inch Rifles on Disappearing Carriages.

1898. $125,000 allotted. Work begun, wharf completed, necessary buildings and plant erected. Platforms completed ready for guns. **98,** 741.

1899. $51,500 allotted. Battery completed except minor details. Two carriages received mounting them in progress. Summary of work. **99,** 927.

1900. Old armament removed from parapet of old fort and parked; electric plant installed. Corrections made by the Ordnance Department of carriages. Minor work completed and battery turned over to the Artillery on June 4, 1900. Summary of work. **00,** 945.

1901. Base circles in w. emplacement raised, electric plant cared for, and storage battery charged. **01,** 837.

1902. Exudations of asphalt waterproofing effectually stopped. **02,** 741.

Part 12, FGR. Mobile, Ala.—Site 2—Battery for Two 8-inch Rifles on 15-inch Rodman Carriages.[1]

1898. $12,000 allotted. Creosoted pile wharf built and constr. materials purchased. **98,** 742.

1899. $8,000 allotted. Concrete work begun and 1,017 c. y. placed, completing same. Carriages and guns received and mounted. Battery completed except raising the parapet. Summary of work. **99,** 931.

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[1] This was torn out and replaced by Battery Stanton,

Part 13, FGR. Mississippi Coast—Fort on Ship Island.

1862. Work begun. **80,** 48.

1866. Work begun in July with turning the arches supporting the parados; completion of the breast-height wall, culvert arches, and mastic covering. Terreplein graded. **66,** 16.

1867. Work completed ready for armament. **67,** 14.

1868. Repairs to slopes. **68,** 18.

1870. Modification plans being prepared. **70,** 25.

1871-73. Care and preservation. **71,** 22; **72,** 19; **73,** 21.

1874. Temporary br. erected across drawbr. wall; two 15-inch Rodman guns and two 100-pounder Parrott guns mounted by the Ordnance Department. **74,** 25.

1875. Care and preservation. **75,** 25.

1876. St. flagging completed; repairs to quarters. **76,** 26.

1877. General repair of buildings. **77,** 21.

1878. Care and preservation. **78,** 25; **79,** 29.

1880-81. History; care and preservation. **80,** 49; **81,** 49.

1882-84. Care and preservation and work on jetties. **82,** 47; **83,** 43; **84,** 48.

1885. Care and preservation. **85,** 41.

1886. Fourteen shot beds built, magazine floors cemented over, and shutters repaired. **86,** 42.

Part 14, FGR. Site 1—Emplacement for 4.7-inch R. F. Gun.

1898. $15,000 allotted. Work begun on 2 emplacements, platform built, and guns and carriages mounted. Concrete work of parapet nearly completed. Magazines waterproofed with 4 layers of asphaltic cement and felt. **98,** 740.

1899. Battery completed in all its details and transferred to the Artillery. Summary of work. **99,** 927.

1902. Damp spots in magazine corrected by waterproofing, painting ironwork, and sodding slopes. **02,** 742.

Part 15, FGR. Site 1—Mortar Battery for Eight 12-inch B. L. Mortars.

1899. $140,000 allotted. Work begun, plant installed, 2,579 c. y. sand placed in parade; 3,278 c. y. concrete, including 591 sq. y. granolithing, placed. Anchor bolts set and platforms completed. Eight carriages received. **99,** 926.

1900. 7,831 c. y. concrete placed, completing same; waterproofing battery; electric plant installed; mounting carriages in progress. Summary of work. **00,** 943.

1901. $16,250 allotted ($2,000 withdrawn). Sand filling completed; observation stations completed; grading and sodding; installation of electric plant completed; ironwork repainted; locks placed on doors, etc. Work of Engineer Department on this battery practically completed. **01,** 836.

1902. Battery transferred to Artillery May 20, 1901. Covering of w. flank traverse and central traverse slid into pit, breaking down concrete cornice; repairs made; $4,500 allotted. Under allotment of $150 light interior doors installed at entrance of each powder magazine. **02,** 740.

Part 16, FGR. Site 1—Emplacements for Two 15-pounder R. F. Guns.

1899. $9,000 allotted. Work begun. **99,** 929.

1900. 549 c. y. concrete placed, 2,188 c. y. sand placed in parapet, and battery completed and turned over to the Artillery on June 4, 1900. Summary of work. **00,** 946.

Part 17, FGR. Site 2—Emplacements for Two 6-inch R. F. Guns on Disappearing Carriages.

1899. $55,000 allotted. Materials being purchased. **99,** 932.

1900. $15,000 allotted. Work begun July 17, 1899. 4,300 c. y. concrete placed, completing same, except steps and walks in rear of battery. Sand filling, steel platforms and stairs in rear, electric-light plant, ammunition service, and minor work remain unfinished. Summary of work. **00,** 949.

1901. Stairways constr., pavements finished, ammunition cranes, trolleys, and trolley beams installed; cables laid, wood and iron work painted, and other misc. work. Emplacements practically completed and turned over May 20, 1901. **01,** 838. $750 allotted for mounting carriages. **01,** 838.

1902. Completing drainage system, hoods for doors and windows, sodding, etc.; work on mounting guns in progress. **02,** 745.

Part 18, FGR. Emplacements for Two 15-pounder R. F. Guns.

1901. $10,000 allotted. Work begun early in September, practically completed latter part of February, **01,** 838.

1902. Wood and iron work, painting, sodded slope cared for, small amount of waterproofing done. **02,** 742.

Part 19, FGR. Miscellaneous.

Peace storage magazine. $7,350 allotted for constr. peace storage magazine; work nearly completed. **02,** 743.

Part 20, FGR. Preservation and Repair—Mobile, Ala.

1897. $850 allotted for a fence on the e. boundary line of Fort Morgan reservation; barbed-wire fence, 3,350′ long, built. **97,** 722. $3,000 allotted for repair of platforms of 8-inch converted rifles and other necessary work. **97,** 722.

1898. Main line of fence repaired and connection made with old fence at se. salient of Fort Morgan. **98,** 737. The platforms for 8-inch converted rifles completed and rifles and carriages mounted and turned over to the garrison. **98,** 737.

1899. $1,675 allotted and ditch cleaned; parade of old fort leveled; repairs to glacis; and sea wall partly rebuilt. **99,** 930. $1,175 allotted and ditcu cleaned; 2 pumps, driven by a heavy 12′ windmill, installed to discharge the drainage over the low dam into the B. **99,** 932.

1900. $3,400 allotted. Slopes and fences repaired; old fort cleaned; waterproofing magazines with cork paint, etc. Mine material cared for; sea walls and jetties repaired. **00,** 947.

1901. $2,900 allotted. Permanent bench marks estab.; misc. repairs, painting, etc.; submarine material cleaned. **01,** 839.

1902. $615 allotted. Site 1—survey of e. boundary of reservation; repairs to sea wall, wharves, and office building. (See various work under other batteries.) **02,** 743. $315 allotted. Site 2—repairs to drains at 8-inch rifles; painting iron and wood work at 6-inch guns; repairs to wharf, windmill, pumping plant, etc. **02,** 746.

Part 21, FGR. Range and Position Finders.

1902. $110 allotted for setting bases for Rafferty range finders. **02,** 743.

Part 22, FGR. Sea Walls and Embankments.

Fort Morgan, Ala.—extensive temporary break'r built. 67, 14. Foundation begun for concrete sea wall in combination with the break'r. 68, 18. Work begun on a sea wall to protect the w. or chan. front of the fort; 53 piles driven and capped for outside of the cofferdam, 790 r. f. of sheet piling completed, and 1,000 c. y. of sand removed. 73, 21. Sea wall completed. 74, 26. $27,000 allotted for extension of sea wall; work begun. 77, 21. Extension completed, 750′ long. 78, 24. $3,934.75 allotted and sea wall repaired. 81, 48. $5,570 allotted for extension and completion of the brush and st. revet. in front of sea wall; work nearly completed. 82, 46. $3,767 allotted for completion of aprons in front of sea wall and 606 r. f. of mattresses placed. 83, 42. Est. cost of protecting shore, $14,000. 96, 523. Work begun on sea wall with funds remaining from allotment for Fort Gaines; 1,988.8 sq. y. fascine mattress and 1,325 c. y. r. placed, completing same. 98, 737.

1901. Work on n. beach completed; entire length, 3,704 l. f. 01, 841.

1902. Riprap sea wall 235′ long constr. 02, 746.

Fort Gaines—270 palmetto piles driven in constr. of 5 jetties for the protection of the shore and glacis. 73, 21. Four jetties completed. 74, 26. Est. cost of protecting shore, $11,000. 96, 522. $25,000 allotted for sea wall to be built under contract; work begun. 97, 722. 4,620.9 sq. y. fascine mattress and 1,960 c. y. st. placed, completing sea wall. 98, 737.

Mississippi Sound—$5,584 allotted for constr. of 3 jetties for protection of the fort. Jetties completed and, in addition, a plank bulkhead 714′ long built. 82, 47. Jetties extended. 83, 43. Jetty 480′ long built. 84, 48. $20,000 allotted for extending riprap sea wall; extension completed for 850′ and the fascine mattress placed for 850′ addl. 99, 930. Work on sea wall completed; 1,800 l. f. built and an extension of 370 l. f. built. Work in progress. Description of sea wall and summary of work. 00, 948.

Part 23, FGR. Submarine Mines—Mobile, Ala.

1895. $7,500 allotted for a mining casemate; work begun. 95, 11.

1896. $3,200 allotted. Work on mining casemate and cable gallery completed, except revetting slopes. Itemized cost of work. 96, 521.

1897. $4,675 allotted. Casemate and cable gallery completed and work begun on a cable tank. 97, 723.

1898. Casemate fitted up for operating mines on the Abbott system, and torpedo materials stored. 98, 742. Concrete cable tank completed and a traveling crane installed. Description of tank. 98, 742. Three casemates cleaned and repaired, and torpedo material stored. 98, 743. $1,000 allotted for planting mines; dynamite and other supplies purchased; searchlight installed. Mines planted and a base line selected, and stations prepared at each end of it for firing the mines by judgment; description. $10,000 allotted for planting torpedoes; searchlight plant installed, mine field patrolled, and supplies received ready for future preparations. 98, 743.

1899. Mines and cable and torpedo instruments received and stored. All mines that had been planted removed by exploding same. Cable, boxes, etc., cleaned and stored. 99, 933. $750 allotted for supplies for operating searchlight plants. 99, 934.

1900. A half mile of multiple cable received and searchlight plant crated and stored. 00, 949.

Part 24, FGR. Supplies for Seacoast Defenses.

1900. $600 allotted. No expend. made. 00, 952.

1901. Boiler repairs and replacing positive groups with new ones in electric plant of 12-inch battery. 01, 841.

1902. $300 allotted. Materials purchased and transferred. 02, 746.

FGS. LOUISIANA-TEXAS FORTIFICATIONS.

(NOTE.—Reports on these works from 1903 to 1912 are of a general character only. See the first 15 pages of each annual report from 1903 to 1912.)

Part.	Title.	Period.
1	Contracts	1897
2	Engineering features	....
3	Engineers—Chief of Engineers	1866–1912
4	BE	1882
5	In charge	1866–1902
6	Assistants	1898–1902
7	Forts, etc. (allotments, operations, etc.)	1819–1912
8	Rigolets Pass., La.—Fort Pike	1819–1885
9	Lake Borgne—Chef Menteur Pass, Fort Macomb	1822–1885
10	Battery Bienvenue	1826–1880
11	Tower Dupres	1830–1880
12	Tower at Proctorville	1856–1880
13	Mississippi R.—Fort Jackson	1822–1869
14	Fort St. Philip	1841–1898
15	New Orleans, La.—Emplacements, two 10-inch guns	1895–1900
16	8-inch battery—emplacements, two 8-inch rifles, disappearing carriages	1898–1899
17	Battery, two 4.7-inch R. F. guns	1898–1899
18	8-inch B. L. rifle on 15-inch S. B. carriage	1898–1899
19	Emplacements, two 8-inch rifles, disappearing carriages	1898–1900
20	First battery—emplacements, two 15-pounder R. F. guns	1899–1901
21	Second battery—emplacements, two 15-pounder R. F. guns	1899–1901
22	Two 15-pounder R. F. guns, second battery	1901–1912
23	Emplacements, four 6-inch R. F. guns	1901–1902
24	Barataria Bay, La.—Fort Livingstone	1842–1886
25	Sabine Pass, Tex.—Battery, 8-inch rifle on 15-inch S. B. carriage	1899
26	Temporary siege batteries	1898–1899
27	Battery, 8-inch rifles, 15-inch S. B. carriage	1898–1899
28	Miscellaneous (electric-light plant; leveling gun platform)	1899–1902
29	Preservation and repair	1898–1902
30	Range and position finders	1901–1902
31	Sea walls and embankments	1883–1902
32	Sites	1901–1902
33	Submarine mines	1898–1900
34	Supplies	1901–1902

Part 1, FGS. Contracts.

1897. Cement, 10,667 barrels, at $2.37 per barrel; gravel and r., 11,056 c. y., $2.63 per c. y.; sand, 4,180 c. y., $1.446 per c. y.; hollow tile, 2,000, 14½¢ each. **97,** 734.

Part 2, FGS. Engineering Features.

Concrete, cost per c. y. **98,** 751. Forms. **97,** 732. Mixing and placing. **97,** 732, 734; **99,** 939. Settlement of (tracing). **90,** 746; **99,** 935, 938, 939, 942, 944.

Condensation, preventing. **03,** 2415.

Lining, magazines. **04,** 3728 (pl.).

Materials, cost of. **97,** 734; **98,** 751.

Mines, submarine, planting and removing. **98,** 756; **99,** 945. Suggestions for imp. **99,** 943.

Percolation, preventing. **03,** 2415.

Pile driving (tracing). **97,** 730; **98,** 747, 748; **99,** 941.

Plant, constr. **98,** 747, 754.

Waterproofing methods. **97,** 735; **98,** 745, 751; **99,** 936, 938, 939; **00,** 953.

Part 3, FGS. Engineers.

Chief of Engineers. R., **66,** 17; **67,** 14; **68,** 18; **69,** 18; **70,** 25; **71,** 22; **72,** 20; **73,** 21; **74,** 26; **75,** 25; **76,** 26; **77,** 21; **78,** 25; **79,** 29; **80,** 49; **81;** 49; **82,** 47; **83,** 44; **84,** 49; **85,** 42; **86,** 42; **95,** 11; **96,** 19, 523; **97,** 18, 727; **98,** 28, 744; **99,** 32, 934; **00,** 28, 952; **01,** 30; **02,** 30; **03,** 9; **04,** 5, 9, 10; **05,** 5; **06,** 6; **07,** 5, 9; **08,** 9, 14; **09,** 15; **10,** 12, 16; **11,** 8, 13; **12,** 7, 12.

Part 4, FGS. Board of Engineers.

Constituted, 1882, to consider and report upon the condition of fortifications, and what number, if any, could be dispensed with. **82,** 425.

Part 5, FGS. Engineers in Charge.

Capt. J. C. Palfrey, 1866.
Capt. J. M. Wilson, 1866.
Maj. M. D. McAlester, 1866–69.
Capt. W. E. Merrill, 1866.
Maj. F. E. Prime, 1869.
Capt. G. J. Lydecker, 1869.
Maj. C. W. Howell, 1869–82.
Maj. A. Stickney, 1882–85.
Capt. T. Turtle, 1885.
Maj. W. H. Heuer, 1885–86.
Maj. J. B. Quinn, 1895–1900.
Lt. C. S. Riché, 1897.
Maj. H. M. Adams, 1900–02.
Lt. Edw. M. Adams, 1901–02.

Part 6, FGS. Assistants.

Lt. F. W. Allstaetter, 1898–99.
Capt. H. Jervey, 1897–99.
Lt. C. S. Smith, 1899–1900.
Lt. H. Burgess, 1899.
Lt. Edw. M. Adams, 1901–02.

Part 7, FGS—

FORTS AND BATTERIES.

Part 8, FGS. Fort Pike, Rigolets Pass, La.

1819. Work begun. **80,** 49.

1870. Est. cost of proposed modifications, necessary repairs, and placing in the curved barbette battery a number of 10-inch rifled guns, with traverses between them, $24,000 allotted; a break'r built along the Rigolets and a new wharf built. **70,** 25.

1871. $2,000 allotted for care and preservation. **71,** 22.

1872. Brs., quarters, and break'r repaired. **72,** 20.

1873. Repairs to br. and brick covering of terreplein of main work, and shingle revet. of slopes over breast-height wall of covered way replaced with a sodded slope. **73.** 21.

1874-79. Necessary repairs. **74.** 26; **75,** 25; **76,** 26; **77,** 21; **78** 25; **79,** 29.

1880. History of the fort; its importance. **80,** 49.

1881. Care and preservation. **81,** 49.

1882. Care and preservation. **82,** 47.

1884. Minor repairs of brs.; grass, weeds, etc., cut from around the walls and inclosures. **84,** 49.

1885. Grass and weeds cut. **85,** 42.

Part 9, FGS. Fort Macomb, Chef Menteur Pass, La.

1822. Work begun. 80, 49.

1870. Est. cost of proposed modifications, $24,000. 70, 25.

1871. $4,000 allotted for care and preservation. 71, 23.

1873–79. Care and preservation. 73, 22; 74, 26; 75, 25; 76, 26; 77, 22; 79, 29.

1880. History and importance. 80, 49.

1881. Care and preservation. 81, 49.

1882. Care and preservation. 82, 48.

1885. Grass and weeds cut. 85, 42.

Part 10, FGS. Battery Bienvenue, on Bayou Bienvenue, Near Lake Borgne, La.

1826. Work begun. 80, 50.

1871. $1,000 allotted for care and preservation. 71, 23.

1872. Quarters, slopes, and brs. repaired. 72, 20.

1873–77. Care and preservation. 73, 22; 74, 26; 75, 26; 76, 26; 77, 22.

1880. History and importance of battery. 80, 50.

Part 11, FGS. Tower Dupres, Lake Borgne, La.

1830. Work begun. 80, 50.

1871. $1,000 allotted for care and preservation. 71, 23.

1873. Some floors relaid, interior of walls of tower repaired, doors hung, and tower cleared of rubbish. 73, 22.

1874. Repairs of tower completed and a keeper placed in charge. 74, 26.

1877. Care and preservation. 77, 22.

1880. History. 80, 50.

Part 12, FGS. Tower at Proctorville, Lake Borgne, La.

1856. Work begun. 80, 50.

1871. $360 allotted for care and preservation. 71, 23.

1875–79. Care and preservation. 75, 26; 76, 27; 77, 22; 78, 25; 79, 30.

1880. History and importance. 80, 50.

Part 13, FGS. Fort Jackson, Mississippi River, La.

1822. Work begun. 80, 50.

1866. Work begun reinforcing barbette platforms to adapt them to larger calibers. 66, 17.

1867. Modification of 22 barbette platforms completed, 16 shot platforms finished, and 2 platforms for 13-inch mortars begun. 67, 14.

1868. Repairs to levees and to main work. 68, 19.

1869. Lightning rods erected over magazines and slight repairs made. 69, 18.

1870. Est. cost of proposed modifications, $191,000. 70, 26.

1871. $60,000 app. Levees repaired and property cared for. 71, 23.

1872. $64,000 app. Work begun, necessary buildings erected, plant purchased, levees and a draining machine to protect the site of the fort from overflow built, slopes repaired, RR. built, and completion of concrete work for 5 magazine traverses in the lower battery. 72, 21.

1873. $65,000 app. E. battery, 2 covered-face batteries, and battery in the n. bastion of main work completed, except gun platforms and masonry breast-height walls. 73, 22.

1874. $30,000 app. Work on drainage, regrading new earthwork, providing 20 wooden platforms for 15-inch guns, laying 4 foundations for platforms, providing material for 16 foundations, and constr. concrete piers for 3 brs. across moat. 74, 26.

1875. $25,000 app. Completion of 18 emplacements for 15-inch guns; work on permanent breast-height walls, slopes, brs., casemate storerooms, quarters, and minor work. 75, 26.

1876. Sally port built to connect lower battery with lower covered-way battery; work on 2 platforms and breast-height wall, magazine traverses, and repairs to slopes, etc. 76, 27.

1877-79. Care and preservation. 77, 22; 78, 25; 79, 30.

1880. History; description and importance. 80, 50.

1881. Care and preservation. 81, 51.

1882. Care and preservation. 82, 49.

1883. Work on levees. 83, 45.

1884. Repairs to brs., quarters, and buildings; drains cleaned; 12 shot beds built, and shot and shell piled; a number of guns, carriages, and chassis moved and blocked; levees completed, and a temporary revet. placed to protect the new levee. 84, 50.

1885. New wharf built and 2 st. platforms for 15-inch guns completed. 85, 44.

1886. Eight concrete and wooden platforms for 15-inch guns replaced with concrete platforms for same guns and a new levee built. 86, 44.

1898. Repairs of buildings, brs., fences; resurfacing elevated gallery of main work; a number of old guns mounted. 98, 745.

Part 14, FGS. Fort St. Philip, Mississippi River, La.

1841. Work begun. 80, 51.

1866. Reinforcing the barbette platforms to adapt them to heavier guns begun and nearly completed. 66, 17.

1867. The magazine in the lower battery, 15 new gun platforms, 2 mortar platforms, with necessary modification of parapets, breast-height walls, and terrepleins completed, and repairs made to br. across ditch and to 2 gun platforms. 67, 14.

1868. Levees repaired and a new levee built from the lower end of the front levee to the bayou. 68, 19.

1869. Minor repairs. 69, 18.

1870. Est. cost of proposed modifications, $108,000. Minor repairs to levees. 70, 26.

1871. $37,500 app. 71, 23.

1872. $42,500 app. Modification work begun. Necessary buildings erected for employees, levee rebuilt, wharf repaired; completion of concrete work for 2 magazines and work in progress on 3 others; building parapet of new battery. 72, 21.

1873. $50,000 app. Completion of levee, 6 traverse magazines in the new and lower water battery, and demolition of the old works. Emplacements for 12 guns ready for platforms. 73, 22.

1874. $30,000 app. Completion of 3 magazine traverses, parapet, and temporary breast-height wall of the lower battery; repairs to slopes; demolition of old magazines and minor work. Summary of work. 74, 27.

1875. $25,000 app. Completion of 6 magazine traverses; repairs to temporary breast-height walls; completion of 18 platforms for 15-inch guns; minor work and repairs. 75, 26.

1876. Three magazines built and 3 traverses completed up to the crown of the arches; foundation of sally-port completed and weighted; 2 wooden platforms placed and excavation made for 7 more; wharf extended and repaired; drains built; reservation resurveyed and the boundaries marked with st. monuments. 76, 27.

1877-79. Care and preservation. 77, 22; 78, 26; 79, 30.

1880. History and description. 80, 51.

1881. Care and preservation. 81, 51.

1882. Care and preservation. 82, 49.

1884. Eight new shot beds built, 3 repaired; guns, carriages, and chassis blocked up; ditches and drains cleaned; brs. repaired; new levee built in front of the old one; a barbed-wire fence built along the river front and on the levee. 84, 51.

1885. New wharf built and a barbed-wire fence built to keep cattle off the levee and grounds. 85, 44.

1886. Replacing 8 concrete and wooden platforms for 15-inch guns with concrete platforms. 86, 44.

1898. Repair of buildings, brs., roof of magazine; minor work; a number of old guns mounted. 98, 745.

Part 15, FGS. New Orleans, La.—Emplacements for Two 10-inch Guns.

1895. $70,000 allotted. Plans being prepared. 95, 11.

1896. $55,000 allotted. Work begun; necessary buildings for employees erected. Piles driven in the emplacements of the battery and part of the excavation completed. $850 allotted for an iron-girder br. across moat. Work completed under contract for $809. 96, 524.

1897. $28,000 allotted. Plans revised. 11,000 c. y. concrete and 12,000 c. y. earth placed, nearly completing concrete work and parapet; ironwork placed; because of concrete work of parapet and platforms settling more work required. Summary of work with itemized cost. 97, 727.

1898. $9,000 allotted. Platforms releveled, guns and carriages mounted, and the completed battery turned over to the Artillery June 7, 1898. Description of releveling with tracing. 98, 746.

1900. $216 allotted. Handrails placed. 00, 953.

Part 16, FGS. New Orleans, La.—Eight-inch Battery—Emplacements for Two 8-inch Rifles on Disappearing Carriages.

1898. $90,500 allotted. Work delayed because of yellow fever. Pile driving begun in December, 1897; 1,340 piles driven; concrete work begun on Apr 6, 1898. Guns and carriages mounted and work nearly completed. Description of pile driving with tracing; waperproofing; itemized cost of battery. **98,** 746.

1899. Battery completed and guns tested. report, with tracing, of the settling of the battery. $3,300 allotted for earth filling between 8-inch and 10-inch batteries and building a concrete walk in rear. 4,000 c. y. earth placed and a walk 550′ x 8′ built. **99,** 934, 936.

Part 17, FGS. New Orleans, La.—Battery for Two 4.7-inch R. F. Guns.

1898. $7,000 allotted. Guns to be mounted temporarily on the face cover, using the existing magazines and parapets. **98,** 752.

1899. Emplacements completed, guns mounted and tested, old magazine repaired, and earthwork completed and sodded. **99,** 936.

Part 18, FGS. New Orleans, La.—Eight-inch B. L. Rifles Mounted on 15-inch S. B. Carriages.

(See emplacements for 8-inch guns on disappearing carriages.)

1898. $10,000 allotted. No work done; awaiting the arrival of 8-inch rifles. **98,** 752.

1899. Guns received. Work begun on altering carriages; work completed and guns mounted. Heavy concrete breast wall built in front of the old platforms; some earth filling. Guns dismounted and transferred to other emplacements. **99,** 937.

Part 19, FGS. New Orleans, La.—Emplacements for Two 8-inch Rifles on Disappearing Carriages.

(See emplacements for 8-inch rifles on 15-inch S. B. guns.)

1898. $125,000 allotted. Work begun; wharf built; pile driving completed; concrete work in progress. Description and cost of plant and summary of work and difficulties attending it. **98** 753.

1899. $25,000 allotted. Concrete work completed; 3,800 c. y. placed: carriages received and mounted. Description of waterproofing. Settlement, and general work. **99,** 937. $1,600 allotted. Rifles transferred on a deck barge and mounted by June 17, 1899. **99,** 940.

1900. $34 allotted. Handrail placed on 1 emplacement. **00,** 953. Carriages cleaned and leveled. $600 allotted for ammunition hoists; erected. $4,848 allotted for removing old brick parapet, so as to give a clear view of the R. Part of old parapet and an old magazine on the parapet blasted and removed; 4,000 c. y. earth removed from tops of 5 old magazines: 13 obsolete guns and carriages dismounted and stored. **00,** 955.

Part 20, FGS. New Orleans, La.—First Battery—Emplacement for Two 15-pounder R. F. Guns.

1899. $24,500 allotted Work begun Dec. 28, 1898. Excavations pile driving, grillage, and concrete work nearly completed; earth slopes finished and battery completed, awaiting the mounts. Summary of work. **99,** 940.

1900. Earth slopes repaired. Wires placed or electric lights and walk to connect with 8-inch and 10-inch batteries built. No guns or carriage received. **00,** 952.

1901. Base castings placed and platforms completed; guns mounted by troops; transferred to garrison Jan. 17, 1901. **01,** 842.

Part 21, FGS. New Orleans, La.—Second Battery— Emplacements for Two 15-pounder R. F. Guns.

1899. $24,500 allotted. Work begun Dec. 28, 1898. Excavations, pile driving, earth slopes, and concrete work completed, awaiting arrival of mounts. Summary of work. **99,** 941.

1900. Electric wires placed. Earth slopes repaired and parade graded. No guns or carriages received. **00,** 955.

1901. Guns mounted by troops. **01,** 845.

Part 22, FGS. New Orleans, La.—Two 15-pounder R. F. Guns, Second Battery.

1901. $10,000 allotted. Work commenced June 25, 1900; emplacements completed September, 1900, with the exception of gun platforms. **01,** 842; **02,** 748.

Part 23, FGS. New Orleans, La.—Emplacements for Four 6-inch R. F. Guns.

1901. $80,340 allotted. Preparation for constr. made; materials ordered; work commenced; site cleared; plant erected. **01,** 843.

1902. Foundations for 2 emplacements completed; concrete work completed; electric lights and switchboards placed in magazines; site for second 2 emplacements acquired; materials for this battery ordered. **02,** 748.

Part 24, FGS. Fort Livingstone, Barataria Bay, La.

1842. Work begun. **80,** 51.

1870. Est. cost of proposed modifications, $38,000. **70,** 26.

1871. $202.50 expended on general repairs. $2,500 allotted for care and preservation. **71,** 24.

1873-79. Care and preservation. **73,** 23; **74,** 27; **75,** 26; **76,** 27; **77,** 22; **79,** 31.

1880. History and description. **80,** 51.

1884. Repairs to slopes; shot beds built; dismounted guns raised and blocked; minor work. **84,** 51.

1885. Quarters repaired. **85,** 45.

1886. Survey made, and plans and ests. prepared for jetties to protect shore line of site from further erosion by the sea. **86,** 44.

Part 25, FGS. Sabine Pass, Tex.—Battery for 8-inch Rifle on 15-inch S. B. Carriage.

1899. $6,000 allotted. Work begun June 6; about one-fourth completed. $3,120 allotted for wharf; wharf 960′ long completed. Gun and carriage received. Carriage altered and gun mounted. All ordnance and ordnance stores turned over to the ordnance sergeant. **99,** 948.

Part 26, FGS. Sabine Pass, Tex.—Temporary Siege Batteries.

1898. $4,200 allotted for temporary batteries for two 5-inch siege guns and two 7-inch siege howitzers. Work begun in April and completed. Armament received and mounted. All guns, carriages, armament, and ammunition pertaining to these guns were shipped to Tampa, Fla., and 4 light 12-pounder S. B. guns and carriages for same were mounted; work incomplete. **98,** 764.

1899. Embrasures cut in breast-height wall to permit the use of smaller guns and parapet raised. Lease of land changed to include sufficient ground for an 8-inch gun emplacement. **99,** 949.

Part 27, FGS. Sabine Pass, Tex.—Battery for 8-inch Rifle on 15-inch S. B. Carriage.

1898. $6,000 allotted. Work begun June 6; about one-fourth completed. $3,120 allotted for wharf; work begun and nearly completed. **98,** 764.

1899. Earthwork and magazine and platform completed. Gun and carriage received. Carriage altered and gun mounted. All ordnance and ordnance stores turned over to the ordnance sergeant. A wharf 960′ long completed. **99,** 948.

Part 28, FGS. Miscellaneous.

Electric-light plants. $1,146.84 allotted and plants installed; description with cost. **99,** 942. $5,250 allotted for a permanent house; house completed, but owing to the unequal settlement of foundations the wall fell in. New site selected and work begun. **99,** 943. $1,900 allotted for operating electric plant; necessary materials purchased. **99,** 944.

1900. Permanent house for electric plant completed; dynamos boiler, and engine cleaned, repaired, and placed on their foundations and the completed building transferred to the garrison. **00,** 952.

Releveling gun platforms, etc., of new batteries. $6,545 allotted. 8-inch and 10-inch emplacements—magazines waterproofed and gun platforms releveled. $400 allotted for raising and leveling base rings of 10-inch battery; work completed. **00,** 953.

1902. $2,885 allotted for releveling base rings of 10-inch platforms; work completed. **02,** 749.

Part 29, FGS. Preservation and Repair.

1898. $4,000 allotted. Fort St. Philip—repairs to buildings, brs. magazines, and cisterns. Fort Jackson—repairing brs. fences, and gallery of main fort. $3,500 allotted for mounting old guns at Forts Jackson and St. Philip; work completed **98,** 744.

1899. New Orleans—$1,000 allotted or repairs to slopes and machinery and care o property. $250 allotted for moving and storing torpedoes and preparing a casemate for same. $3.25 allotted for a new tangent wheel for ammunition lift at 10-inch battery. **99,** 944. Sabine Pass—$310 allotted for repair of magazine floors, drains, buildings, erecting a wire fence, and care of property. **99,** 950.

1900. New Orleans—$1,870 allotted. General repair of guns and carriages, slopes, buildings, and machinery. **00,** 953. $4,219.50 allotted; slopes repaired, torpedo material cleaned and stored, plant cleaned and repaired, gun platforms releveled care of property. **00,** 955.

1901. $6,000 allotted for repairing leaks, painting, whitewashing, etc., and repairs to superior slope of 8-inch gun battery. **01,** 844. $115 allotted for changing location of electric-light wires and poles; work completed. **01,** 844, 845. $1,200 allotted for painting ironwork, placing hood and collar on smokestack, and other minor work. **01,** 845. $440 allotted for hire of watchmen. **01,** 846. $1,000 allotted for repairing slope of 8-inch gun battery, painting ironwork, whitewashing, caring for plant. **01,** 846.

1902. Site 1—$1,590 allotted for repairs to handrails, 10-inch gun battery; wooden steps 8-inch battery replaced by concrete; quarters and wharf repaired. **02,** 751. Site 2—$360 allotted for care of torpedo property; repairs to buildings; loading platforms; exterior of casemate rendered dry by coating of asphalt. **02,** 751.

Part 30, FGS. Range and Position Finders.

1901. $8 allotted. Iron rails placed. **01,** 843.

1902. $13,500 allotted for fire-commander's station; work on foundation completed; work on erecting tower in progress. **02,** 748, 749.

Part 31, FGS. Sea Walls and Embankments.

Fort Jackson—$5 926.21 allotted for constr. and repair of levees; work in progress. 83, 45. Levee completed and a temporary revet. built to protect same. 84, 50. New levee built. 86, 44.

Fort St. Philip—new levee built in front of the old one from the upper end of the reservation to where the back levee begins, and from this point to the lower end of the reservation part of the old front levee was repaired. The back levee rebuilt. 84, 51.

1901. $2,400 allotted for repairing and raising front of levee of R. side of reservation. 02, 844.

1902. $2,400 allotted. Land drained and cleared of drift; storm damaged levee; levee rebuilt; work completed. 02, 750.

Part 32, FGS. Sites.

1901. $250 allotted for tract of land to be acquired by condemnation. 01, 842.

1902. $515 allotted for purchasing tract of land for site of 6-inch R. F. guns. 02, 749.

Part 33, FGS. Submarine Mines.

1898. New Orleans—$26,500 allotted. Mines planted. Description in detail with cost. 98, 755. Sabine Pass—$3,600 allotted; mines, dynamite and electrical supplies received and stored awaiting receipt of cables. 98, 764.

1899. New Orleans—$2,714.93 allotted for installing searchlight and operating casemate; work completed. 99, 942. $5,366.23 allotted for torpedo defense of New Orleans; all mines removed. Description of method of removing mines with results and suggestions for imp. 99, 945. Sabine Pass Tex.—10 mines, with necessary supplies, received. No mines planted. All torpedo material transferred to ordnance sergeant. 99, 950.

1900. $3,675 allotted for a torpedo storehouse; work completed and material stored. 00, 956.

Part 34, FGS. Supplies for Seacoast Defenses.

1901. $500 allotted for purchase of supplies; hood and collar for smokestack of dynamo house installed. 01, 845.

1902. $500 allotted. Supplies purchased and issued; reflectors for searchlight purchased. 02, 751.

FGU. TEXAS FORTIFICATIONS.

(NOTE.—Reports on these works from 1903 to 1912 are of a general character only. See the first 15 pages of each annual report from 1903 to 1912.)

Part.	Title.	Period.
1	Contracts	1896–1902
2	Engineering features	
3	Engineers—Chief of Engineers	1879–1912
4	BE	1882–1901
5	In charge	1896–1902
6	Assistants	1896–1902
7	Forts, etc. (allotments, operations, etc.)	1879–1912
8	Galveston, Tex.—Batteries at entrance	1879–1886
9	Emplacement, two 10-inch guns, Battery No. 1	1897–1900
10	Mortar battery No. 1	1897–1900
11	Two 4.7-inch R. F. emplacements	1898–1900
12	Two 10-inch gun emplacements, Battery No. 2	1898–1900
13	Two 8-inch gun emplacements	1898–1900
14	Two emplacements, 15-pounder R. F. guns, Battery No. 1	1899–1900
15	Two emplacements, 15-pounder R. F. guns, Battery No. 2	1899–1901
16	Three emplacements, 15-pounder R. F. guns	1899–1900
17	Mortar battery, No. 2	1899–1902
18	Emplacements, two 6-inch guns	1900
19	Site 1	1902
20	Reconstr., battery, two 10-inch guns, disappearing carriages	1902
21	Reconstr., battery, 12-inch mortars	1902
22	Repair, battery, two 4.7-inch R. F. guns	1902
23	Repair, battery, two 3-inch R. F. guns	1902
24	Site 2—Repair, battery, two 10-inch guns, disappearing carriages	1902
25	Repair, battery, eight 12-inch mortars	1902
26	Repair, battery, two 3-inch R. F. guns	1902
27	Site 3—Repairs, battery, two 8-inch guns, disappearing carriages	1902
28	Repair, battery, 3-inch R. F. guns	1902
29	Miscellaneous (electric plant; restoration of grounds, etc.; storm)	1899–1901
30	Preservation and repair	1899–1901
31	Range and position finders	1901
32	Sea walls	1901
33	Sites	1897–1898
34	Submarine mines	1896–1902

Part 1, FGU. Contracts.

1896. Battery for eight 12-inch mortars, $96,491.80. **97,** 742.

1899. Electric-light plant for 10-inch battery No. 1 and mortar battery No. 1, $9,248. **99,** 958.

1902. Large and small riprap st., various prices; natural cement, $1.75 per barrel and $1.94 per barrel. **02,** 758.

Part 2, FGU. Engineering Features.

Battery, mortar, reconstr. **04,** 3730.

Carriages, releveling. **99,** 953, 973.

Cement, table of tests. **96,** 526; **97,** 737, 741.

Concrete, cost per c. y. **98,** 766; **00,** 970.

Concrete, ingredients of. **96,** 525; **97,** 737; **99,** 959. Strengths; various tests. **05,** 3027.

Condensation, methods of preventing. **R.** **99,** 951, 960, 970; **04,** 3729; **05,** 3029.

Construction, methods. **05,** 3030 (pl.).

Covering, sand, pumping. **05,** 3029.

Dampproofing, methods. **04,** 3730 (pl.).

Drainage system, description of. **99,** 951

Grillage foundations of old RR iron. **98,** 768; **99,** 955.

Leaks, preventing. **03,** 2417.

Lining, magazine. **03,** 2416 (pl.).

Mines, defects noticed in submarine. **98,** 770.

Mines, description of, method of laying and removing. **98,** 769; **99,** 964.

Percolation, overcoming. **03,** 2416 (pl.); **04,** 3729; **05,** 3029.

Seepage through concrete roof, prevention of. **R.** **99,** 952, 970.

Ventilation, controlling. **05,** 3029.

Walls, sea sheet piling. **05,** 3023 (pl.). Concrete, specifications. **05,** 3024 (pl.).

Part 3, FGU. Engineers.

Chief of Engineers. **R.,** **79,** 31; **80,** 51; **81,** 52; **82,** 50; **83,** 46; **84,** 52; **85,** 45; **86,** 45; **96,** 19, 534; **97,** 19, 737; **98,** 20, 765; **99,** 33, 951; **00,** 29, 958; **01,** 30; **02,** 30; **03,** 9, 16; **04,** 5; **05,** 5, 11, 15; **06,** 5, 9; **07,** 5, 10, 11, 450; **08,** 9; **09,** 10. 16; **10,** 12; **11,** 8, 14; **12,** 7, 12.

Part 4, FGU. Board of Engineers.

1882. Constituted to consider and report upon the constr. of fortifications, and what number, if any, could be dispensed with. **R.,** **82,** 427.

1901. Constituted to examine damages made by storm of Sept. 8, 1900. **R.,** **01,** 850. (Col. H. M. Robert, Maj. H. M. Adams, Capt. C. S. Riché. **01,** 850.)

Part 5, FGU. Engineers in Charge.

Lt. Col. A. M. Miller, 1896–98.
Capt. C. S. Riché, 1898–1902.
Maj. J. B. Quinn, 1898–99.

Part 6, FGU. Assistants.

Lt. W. V. Judson, 1896–97.
Capt. C. S. Riché, 1897–98.
Lt. H. Burgess, 1898–99. **R.,** **98,** 769.
Lt. M. L. Walker, 1901–02.

Part 7, FGU—

FORTS AND BATTERIES.

Part 8, FGU. Batteries at Entrance to Harbor.

1879–86. Plans made for batteries at Pelican Spit, Galveston Isld., and Bolivar Pt. **79,** 31; **80,** 51; **81,** 52; **82,** 50; **83,** 46; **84,** 52; **85,** 45; **86,** 45.

Part 9, FGU. Emplacement for Two 10-inch Guns, Battery No. 1.

1897. $100,000 allotted. Work begun on 1 emplacement designed for all-around fire and 1 for limited fire, and site raised to a level of 8′ above m. l. t.; concrete work in progress. Summary of work with itemized cost. **97,** 738.

1898. $17,500 allotted. Concrete work and earthwork completed. To protect the parapet from wave action during storms, sheet piling, protected on the outside by riprap, placed. Gun and carriage mounted in s. emplacement; another gun on hand; settlement; carriage in s. emplacement leveled up. Summary of work with itemized cost. **98,** 765.

1899. All-around fire carriage received, mounted with gun, and tested; new drain system completed; waterproofing completed. Itemized cost of emplacement. **99,** 951. $2,500 allotted for concrete splinter-proof power house; work begun and completed. **99,** 953.

1900. Electric plant installed, and the completed battery turned over to the Artillery. Total cost, $117,500. Power house completed; cost, $2,500. **00,** 958.

Part 10, FGU. Mortar Battery No. 1.

1897. $117,700 allotted. Work begun under contract; sheet-piling revet. completed; site of battery raised; mortar platforms completed and made ready for ironwork. Summary of work. **97,** 740.

1898. Concrete work and sand fill completed; $1,600 allotted. Carriages mounted and battery, except installing electric plant, completed. **98,** 766.

1899. New drainage system completed; carriages releveled, and all work, except installing electric plant, completed. Itemized cost of work. **99,** 953.

1900. Electric plant installed; completed battery transferred to the Artillery. **00,** 959.

Part 11, FGU. Two 4.7-inch R. F. Emplacements.

1898. $26,000 allotted. Work begun May 23, 1898. Sheet piling driven around site under contract; 2,000 c. y. sand and 725 t. riprap placed; work in progress. **98,** 768.

1899. $15,000 allotted. Emplacements completed and guns mounted. Itemized cost of work. **99,** 961, 966.

1900. Completed emplacements transferred to the Artillery Oct. 25, 1899. **00,** 966, 970.

Part 12, FGU. Two 10-inch Gun Emplacements, Battery No. 2.

1898. $100,000 allotted. Work begun. 954 piles driven for foundation; grillage of old RR. rails running in both directions and embedded in the concrete, and 5,310 c. y. concrete placed. **98,** 768.

1899. $10,000 allotted. Concrete work completed; carriages mounted; guns not on hand. Description of waterproofing and ventilating systems. Itemized cost of work. **99,** 959, 969.

1900. Guns and carriages received and mounted and battery completed. **00,** 965, 972.

Part 13, FGU. Two 8-inch Gun Emplacements.

1898. $100,000 allotted. RR. track built to connect site of battery with Gulf & Interstate Ry 776 piles driven for foundation; grillage of 2 layers of old RR. iron placed. 4,273 c. y. concrete placed. Platforms ready for base rings. **98,** 769.

1899. $10,000 allotted and $1,000 transferred from 10-inch emplacements; carriage and gun mounting in progress. Summary and itemized cost of work. **99,** 960, 967.

1900. Mounting of guns and carriages completed; waterproofing completed, and the completed battery transferred to the Artillery Oct. 25, 1899. **00,** 966, 971.

Part 14, FGU. Two Emplacements for 15-pounder R. F. Guns, Battery No. 1.

1899. $30,000 allotted for guns on pillar mounts; work begun, trestle built, and pipe laid for filling the site for battery. U. S. dr. boat altered. Itemized cost of work. **99,** 955, 967.

1900. $3,000 transferred from other works. Site filled in, concrete work completed. 741 c. y. placed; 660 c y. riprap placed, and battery completed ready for guns. Itemized cost of work. **00,** 959, 969.

Part 15, FGU. Two Emplacements for 15-pounder R. F. Guns, Battery No. 2.

1899. $15,000 allotted. Work begun January 9, foundation piles driven, and a grillage of old RR. iron laid; concrete work nearly completed, sheet piling revet. completed, emplacement ready for armament. Summary and itemized cost of work. **99, 955, 970.**

1900. $1,500 transferred to other works. Battery, except blast surfaces and part of riprap protection, completed. Sand fill completed; 3,433 c. y. placed. No guns received. **00, 960, 972.**

1901. Hurricane damages revet., washing protection away. No work done. **01, 847.**

Part 16, FGU. Three Emplacements for 15-pounder R. F. Guns.

1899. $30,000 allotted. Work begun January 26; all sheet piling driven, foundation piles driven, grillage of old RR. iron placed, and gun platforms made ready for carriages. Summary of work. **99, 956, 968.**

1900. $1,500 transferred to other works. Concrete work completed, 1,109 c. y. placed; sand protection completed, 4,000 c. y. placed. Battery completed and turned over to the Artillery March 31. No guns or carriages received. Itemized cost of work. **00, 961, 971.**

Part 17, FGU. Mortar Battery No. 2.

1899. $125,000 allotted. Work begun Sept. 17, 1898; foundation piles driven, timber grillage laid, concrete work nearly completed; damp course at the 9-foot elevation under all magazines and an asphalt course over all roofs completed. Summary and itemized cost of work. **99, 957, 969.**

1900. Sand fill completed; 50,245 c. y. placed; 920 t. riprap protection placed; 8 mortars and carriages received. Itemized list of expend. **00, 963, 972.**

1901. Hurricane Sept. 8, 1900, washed down all sand and soil protection; mortars and carriages buried in sand. **01, 847.** (See Work of reconstr., 1902.)

Part 18, FGU. Emplacements for Two 6-inch Guns.

1900. $5,000 allotted. Work begun; 125,000 c. y. sand filling placed on site; sand fences built to prevent cutting of chan. through the site during high tide. **00, 965, 971.**

Part 19, FGU. Site 1.

1902. Work of rebuilding railway trestle and track completed; various machinery and cars rebuilt and repaired. **02, 752.**

Part 20, FGU. Site 1—Reconstruction of Battery for Two 10-inch Guns on Disappearing Carriages.

1902. $175,000 allotted. Work of breaking up old battery under way. **02, 752.**

Part 21, FGU. Site 1—Reconstruction of Battery for 12-inch Mortars.

1902. $290,000 allotted. Removal of carriages and mortars from old battery commenced. **02, 753.**

Part 22, FGU. Site 1—Repair of Battery for Two 4.7-inch R. F. Guns.

1902. $50,000 allotted. Driving of piles, placing of grout, foundation for pavement completed. **02, 753.**

Part 23, FGU. Site 1—Repair of Battery for Two 3-inch R. F. Guns.

1902. $35,000 allotted. Concrete foundation placed around battery; driving of piles. **02, 754.**

Part 24, FGU. Site 2—Repair of Battery for Two 10-inch Guns on Disappearing Carriages.

1902. $85,000 allotted. Sheet piling driven; grouting under battery; riprap filling done. **01, 755.**

Part 25, FGU. Site 2—Repair of Battery for Eight 12-inch Mortars.

1902. $180,000 allotted. Foundation piles for walls driven; new e. and w. wing walls constr.; observation station constr. **02, 756.**

Part 26, FGU. Site 2—Repair of Battery for Two 3-inch R. F. Guns.

1902. $30,000 allotted. Sheet piling driven; pavement in rear of battery completed. **02, 756.**

Part 27, FGU. Site 3—Repairs of Battery for Two 8-inch Guns on Disappearing Carriages.

1902. $85,000 allotted. Sand placed to protect piling. 02, 757.

Part 28, FGU. Site 3—Repair of Battery for 3-inch R. F. Guns.

1902. $35,000 allotted. Sand placed to protect piling from action of teredo. 02, 757.

Part 29, FGU. Miscellaneous.

Electric-light plant. **1899.** $10,000 allotted for 10-inch battery No. 1 and 12-inch mortar battery No. 1. Work done under contract; wiring completed; dynamos and engine installed; work in progress. 99, 967.

1900. Installation completed and battery transferred to the Artillery. 00, 963, 971.

Restoring railway approaches and fence around reservation. **1902.** Site 2—$6,000 allotted during year. 4,808 l. f. restored, 550 l. f. track repaired, and 692 l. f. railway trestle built. 02, 758. $8,000 allotted. No work done. 02, 758. Storm of Sept. 8, 1900. (See Sea walls and embankments.)

Part 30, FGU. Preservation and Repair.

1899. $7,100 allotted. Drainage system and waterproofing completed at 10-inch battery No. 1 and slopes repaired at mortar battery No. 1. 99, 968.

1900. $2,455 allotted. Repairing ammunition hoists, slopes; planting Bermuda grass seed on slopes; planting trees; releveling gun platforms; repairing magazine doors; minor work. 00, 964.

1901. $8,500 allotted for preserving and caring for engineer property damaged by hurricane cleaned, oiled, painted, etc. 01, 848. $5,000 allotted for preserving batteries on piling from action of teredo. 01, 849. $18,000 allotted. Preparation of plans; constr. field office and quarters, etc.; erection of plant. 01, 849. $8,000 allotted. Foundation work; reconstr. mining casemate in traverse of 8-inch battery; driving of piles. 01, 754.

Part 31, FGU. Range and Position Finders.

1901. $2,000 allotted. Hurricane seriously damages stations; no work done. 01, 847.

Part 32, FGU. Sea Walls and Embankments.

1901. Report by BE., Nov. 23 1900, upon work necessary for repairing damages to fortifications by storm of Sept. 8, 1900. Est. of $568,000 is submitted, with addition of $238 000 if work is delayed. 01, 850, etc.

Part 33, FGU. Sites.

$71,000 allotted for 1 site. **97, 741.** $4.75 allotted for a second site. **98, 767.**

Part 34, FGU. Submarine Mines.

1896. $10,000 allotted. Work begun on a mining casemate; 111 c. y. concrete placed. Ingredients of concrete. Testing cement. **96,** 19, 524.

1897. $9,562.40 allotted. Work completed; a total of 1,085 c. y. concrete and 10,795 c. y. of earth placed. Total cost $15 009.27. Itemized cost of work. **97,** 737.

1898. $12,000 allotted. Supplies purchased and a temporary line of torpedo defense begun, but discontinued after reception of other material; mines planted and tests made. **98,** 769.

1899. $750 allotted. Searchlight installed on 2 railway flat cars, on the U. S. jetty track. **99,** 963. $3,000 allotted for cable tank; work begun and nearly completed cable stored. **99,** 963. 2,000 allotted for a wooden torpedo storehouse. Work begun and completed except minor work; torpedoes anchors and other submarine mining material stored. **99,** 963. Report on planting and removing mines. **99,** 964.

1900. Cable tank completed and cable stored. **00,** 967. Torpedo storehouse completed and all torpedo material stored. **00,** 968. $5,000 allotted for system of tracks or submarine-mining service; work completed. Itemized cost. **00,** 968, 971.

1902. Site 1—$2,000 allotted for reconstr. of submarine-mine warehouse; work completed; material stored. **02,** 754. $2,200 allotted. Repair of cable tank; building erected over tank. **02,** 754. $5,800 allotted for reconstr. tracks and wharf; work completed. **02,** 755.

FLG.[1] NORTHERN AND NORTHWESTERN LAKES FORTIFICATIONS.

(NOTE.—Reports on these works from 1903 to 1912 are of a general character only. See the first 15 pages of each annual report from 1903 to 1912.)

Part 1, FLG. Engineers.

Chief of Engineers. R., **66,** 2; **67,** 3: **68,** 6; **69,** 7: **70,** 11; **71,** 3; **72,** 3; **73,** 4; **74,** 6; **75,** 5; **76,** 6, **77,** 4; **78,** 6; **79,** 8; **80.** 18; **81,** 14; **82,** 9; **83,** 5: **84,** 10; **85,** 5; **86,** 6: **99,** 33, 974; **00,** 30, 972; **01,** 32; **02,** 7, 33; **03,** 8, 9; **04,** 5; **05,** 5.

BE., 1885. **R.,** **86,** 509.

In charge:
Col. T. J. Cram, 1866–70.
Maj. W. McFarland, 1870–71.
Maj. G. L. Gillespie, 1871–73.
Maj. F. Harwood, 1873–74.
Lt. Col. C. E. Blunt, 1875–78.
Maj. W. McFarland, 1878–83.
Lt. Col. H. M. Robert, 1883.
Lt. Col. O. M. Poe, 1884–86.
Lt. Col. G. J. Lydecker, 1899–1901.
Maj. W. L. Fisk, 1901–02
Col. John W. Barlow, 1901.
Col. S. M. Mansfield, 1901.
Col. John W. Barlow, 1901.
Capt. Harry Taylor, 1901–02.
Capt. G. D. Fitch, 1901.
Maj. T. W. Symons, 1901–02.
Capt. L. H. Beach, 1902.

Assistant. Lt. R. R. Raymond, 1901–02.

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[1] Final G=General.

FLPP. DETROIT, MICH., FORTIFICATIONS.

(NOTE.—Reports on these works from 1903 to 1912 are of a general character only. See the first 15 pages of each annual report from 1903 to 1912.)

Part.	Title.	Period.
1	Contracts	
2	Engineers (see FLG above, and Part 5 below).	
3	Forts, etc. (allotments, operations, etc.)	1841-1901
4	Fort Wayne, Mich	1841-1901
5	Fort Gratiot Military Reservation	1871-1873

Part 1, FLPP. Contracts.

1882. Pointing the nw. front, and 1 face of the n. bastion, $1,240. **82, 9.**

1883. Clearing and pointing scarp walls, $1.15 per sq. y.; clearing and pointing casemate walls, $1.50 per sq. y.; cutting out and replacing damaged brick, $40 per M. **83, 5.**

Part 2, FLPP. (See FGG above, and Part 5 below).

Part 3, FLPP.

FORTS AND BATTERIES.

Part 4, FLPP. Fort Wayne, Mich.[1]

1841. Work begun. **80, 18.**

1862. New work begun. **83, 5.**

1866. Work continued on scarp wall, flanking casemates, breast-height wall, and parapet. **66, 2.**

1867. Work on breast-height wall; doors of casemates and magazines hung: road from dock to the country road finished; drainage begun; gun platforms completed and sodding and embanking of parapet nearly completed. **67, 3.**

1868. Widening of ditch to 25'; glacis graded; lateral batteries laid out; magazines of w. battery completed: doors of w. and e. battery made; ramp leading from roadway up the glacis to the ditch opposite the sally port finished; new main roadway graded and drains rebuilt. **68, 6.**

1869. Widening of ditch completed; glacis completed on nw. front and e. face of the n. bastion: open ditch for drainage constr. and sodded at foot of the glacis; parade ground leveled and a fence to inclose the glacis begun. **69, 7.**

1870. Glacis on the nw., se., and water fronts completed and seeded; drain and fence along its foot built; ironwork painted and slopes mowed. Batteries not yet completed. **70, 11**

1871. Plans for modifying work prepared; care and preservation. **71, 6.**

1872. Care and preservation. **72, 3.**

1873. Paving and sewering done in rear of barracks. **73, 4.**

1874. Perishable equipment and material sold at auction. **74 6.**

1875. Fences partly rebuilt and boundary lines regraded. **75, 5.**

1876. Rebuilding of fences and regrading grounds completed. **76, 6.**

1880. Magazine floor rebuilt. **80, 18.**

1882. Repairing begun: br. coping at the salient and shoulder angles replaced with cut sts.; sally port repaired; masonry of cesspools relaid; 5 casemate penthouses rebuilt; new roof built over magazine, and scarp wall repaired and pointed. **82,** 9.

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[1] $875.25 spent, 1893 to 1906, for repairs, etc.—DETROIT OFFICE.

1883. $10,000 allotted for, completion of work. Scarp wall repaired. **83,** 5.

1884. Repair work completed in 1883. **84,** 10.

1885. Renewal of the demilune magazine roof and of the parade revet. on the sw. front. **85,** 5.

1886. Gun platforms and demilune magazines repaired. **86,** 6. Table showing proposed armament, 1886. **86,** 509.

1899–00. $150 allotted for preservation. **99,** 974; **00,** 973.

1900–01. $150 withdrawn. Removal of revet. suggested. **01,** 855.

Part 5, FLPP. Fort Gratiot Military Reservation, Mich.

ENGINEERS.

Chief of Engineers. R., **71,** 104; **72,** 102; **73,** 116.

Operations.

1871. By acts of July 20, 1868, and Mar. 18, 1870, this reservation was divided into lots of convenient size and 242 were sold. $3,000 app. for defraying expenses. Amount received from sale of lots, $41,524. Another sale contemplated. **71,** 104.

1872. Another sale began Aug. 8, 1872, and continued till all lots offered were sold. Amount received was $58,433.91; a small part unsold. $2,000 app. for properly laying out the streets and lots, **72,** 102.

1873. Act of Mar. 3, 1873, au. the Sec. of War to survey, plat, and sell the cemetery grounds, subject to certain restrictions. No pre. action provided by the statute had been taken by the city of Port Huron. **73,** 116.

FLRR. NIAGARA RIVER FORTIFICATIONS.[1]

(NOTE.—Reports on these works from 1903 to 1912 are of a general character only. See the first 15 pages of each annual report from 1903 to 1912.)

Part.	Title.	Period.
1	Engineers—Chief of Engineers—Buffalo	1866–1868
2	Niagara R.—Fort Porter	1866–1886
3	Fort Niagara	1866–1902
4	In charge—Buffalo	1866–1868
5	Niagara R.—Fort Porter	1866–1886
6	Fort Niagara	1866–1902
7	Forts, etc. (operations, allotments, etc.)	1839–1905
8	Buffalo, N. Y	1866–1867
9	Fort Porter, N. Y	1842–1885
10	Fort Niagara, N. Y	1839–1902
11	Preservation and repair	1890–1900
12	Sea walls and embankments	1890–1901

Part 1, FLRR. Engineers (Buffalo, N. Y.).

Chief of Engineers. R., 66, 3; 67, 3; 68, 6.

Part 2, FLRR. Engineers (Fort Porter, N. Y.).

Chief of Engineers. R., 66, 3; 67, 3; 68, 6; 70, 11; 71, 6; 72, 3; 73, 4; 74, 6; 75, 5; 76, 6; 77, 4; 78, 6; 79, 8; 80, 18; 81, 15; 82, 10; 83, 6, 84, 11; 85, 6; 86, 6.

Part 3, FLRR. Engineers (Fort Niagara, N. Y.).

Chief of Engineers. R., 66, 3; 67, 3; 68, 6; 69, 7; 70, 11; 71, 6; 72, 4; 73, 5; 74, 6; 75, 5; 76, 7; 77, 4; 78, 6; 79, 8; 80, 18; 81, 15; 82, 10; 83, 6; 84, 11; 85, 6; 86, 6; 87, 4; 90, 5; 91, 8, 92, 12; 93, 11; 96, 527; 97, 20, 743; 98, 29, 773; 99, 33, 974; 00, 30, 973; 01, 32, 255; 02, 32, 759.

Part 4, FLRR. Engineers in Charge (Buffalo, N. Y.).

Maj. J. A. Tardy, 1866–67.
Col. T. J. Cram, 1868.
Capt. F. Harwood, 1868.

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[1] See p. 1191.

Part 5, FLRR. Engineers in Charge (Fort Porter, N. Y.).

Capt. and Maj. J. A. Tardy, 1866–67.
Col. T. J. Cram, 1868.
Maj. F. Harwood, 1868–74.
Lt. Col. C. E. Blunt, 1875–78.
Maj. W. McFarland, 1878–83.
Lt. Col. H. M. Robert, 1883–84.
Capt. E. Maguire, 1884–86.

Part 6, FLRR. Engineers in Charge (Fort Niagara, N. Y.).

Capt. J. A. Tardy, 1866–67.
Col. T. J. Cram, 1867–68.
Lt. Col. C. E. Blunt, 1868–69.
Maj. M. D. McAlester, 1869.
Maj. N. Bowen, 1869–71.
Lt. B. D. Greene, 1871.
Maj. J. M. Wilson, 1871–76.
Maj. W. McFarland, 1876–83.
Lt. Col. H. M. Robert, 1883–84.
Capt. E. Maguire, 1884–86.
Maj. M. B. Adams, 1890–91.
Capt. D. C. Kingman, 1890–93. **R., 91,** 517; **92,** 453; **93,** 625.
Maj. W. S. Stanton, 1896–98. **R., 96,** 527.
Lt. Col. A. M. Miller, 1898.
Maj. T. W. Symons, 1899–1900.
Capt. G. D. Fitch, 1899–1901.
Maj. T. W. Symons, 1901–1903.
Maj. T. A. Bingham, 1904.
Lt. P. S. Bond, 1904.
Lt. Col. H. M. Adams, 1905–1907.
Lt. Col. W. L. Fisk, 1908.
Capt. W. L. Guthrie, 1909–10.
Col. G. Y. Warren, 1911–12.

Part 7, FLRR.—

FORTS AND BATTERIES.

Part 8, FLRR. Buffalo, N. Y.

1866. Addl. works for defense to be considered by board of officers. **66,** 3.

1867. Operations awaiting result of experiments and the deliberations of the BE. upon the application of new material to purposes of defense. **67,** 3.

Part 9, FLRR. Fort Porter, Buffalo, N. Y.

1842. Work begun. **80,** 18.

1867–68. Two temporary buildings (storerooms) repaired. **67,** 3; **68,** 6.

1871. Projs. for repair prepared. **71,** 6.

1873–77. Act of July 11, 1870, au. the Buffalo park commissioners to beautify the grounds; work in progress. **73,** 4; **74,** 6; **75,** 5; **76,** 6; **77,** 4.

1881. Keep nearly destroyed by fire many years previous, and the entire work in its existing condition useless for offense or defense. **81,** 15.

1885. Park commisssioners built a roadway, by permission of Sec. of War, Apr. 12, 1884, through the reservation, cutting the rampart of the fort, necessitating the tearing down of the w. angle, including the hot-shot furnace and the R. face. A wooden fence was built along this face. **85,** 6.

Part 10, FLRR. Fort Niagara, N. Y.

1839. Work begun. The work contains 2 masonry blockhouses, built by the French about 1757, and other buildings begun by the French and finished by the English after its capture by them during the French and Indian War. **80,** 18; **81,** 15.

1866. Replacing the old wooden scarp of land fronts with masonry. **66,** 3.

1867. Constr. casemates and some minor work. **67,** 3.

1868. Sally-port arch and land-front arch completed and the dry-st. wall partly finished. **68,** 7.

1869. Casemate arches finished; entrance to flank casemate completed rampart and parapet extended to scarp wall: all dry-st. filling behind walls finished. **69,** 7.

1870. Arched passage to the flank gallery backed with concrete covered with mastic, and parapet formed over it; paved drains behind open scarp wall of the entire land front completed, and minor work. **70,** 11.

1871. Terreplein and parapet of the n. and s. bastions raised. graded, and sodded; building wooden platform for 4½-inch rifled gun and minor work. **71,** 6.

1872. Repairing and pointing scarp wall; constr. sewer and drains in main ditch and grading and seeding same; paving postern road and casemates; repairing sea wall and minor work. **72,** 4.

1873. Cribwork protection at w. angle of fort; jetties on lake front constr.; postern gates made and hung and minor work. **73,** 5.

1874–75. Care and preservation. **4,** 6: **75,** 5.

1876. Main approach damaged by water, being repaired. **76,** 7.

1877. New road built to the fort. **77,** 4.

1878. Damaged masonry of the salient of s. bastion rebuilt. **78,** 6.

1882. Jetties repaired. **82,** 10.

Part 11, FLRR. Preservation and Repair (Fort Niagara, N. Y.).

1890–91. $10,000 allotted. Repairs to lake-front revet.; cribwork base for nw. angle of the break'r completed; cofferdam built and nw. angle of fort wall rebuilt. **91,** 519.

1898. 1,850' of Niagara R. bank seeded. **98,** 774.

1899. Bank repaired and seeded. **99,** 974.

1900. Concrete break'r repaired and bank repaired, sodded, and seeded. **00,** 973.

Part 12, FLRR. Sea Walls and Embankments (Fort Niagara, N. Y.).

1890. $20,000 allotted, 1888, for preservation. Work delayed until Aug. 10, 1889, by stage of water in the lake; 1.811 l. f shore revet. built; breach in work being closed. **90,** 5.

1891. $10,000 allotted. Proj. for protection of site of Fort Niagara. Wall at nw. angle repaired and some dike built. **91,** 518.

1892. Sea wall completed and 941 l. f. of bank graded. **92,** 454.

1893. Retaining wall repaired and tile laid for draining slope. **93,** 626.

1896. Est. cost of protecting 650' of bank in front of the officers' quarters $7,000. **96,** 527.

1897. Lake wall repointed, sts. relaid, and 80' of its foundation protected with riprap. R. bank surveyed. **97,** 743.

1898. 1,850' of Niagara R. bank sloped, graded, and protected with brush fascines and st. ballast. Proj. of 1888 completed. **98,** 774.

1901. Repairs made to injured R. bank. **01,** 8 .

1902–1912. No operations.

FLRR. OSWEGO, N. Y., FORTIFICATIONS.

(NOTE.—Reports on these works from 1903 to 1912 are of a general character only. See the first 15 pages of each annual report from 1903 to 1912.)

Part.	Title.	Period.
13	Engineers—Chief of Engineers	1866–1886
14	In charge	1866–1886
15	Forts, etc. (operations, allotments, etc.)	1839–1902

Part 13, FLRR. Engineers.

Chief of Engineers. R., **66,** 3; **67,** 3; **68,** 7; **69,** 7; **70,** 12; **71,** 6; **72,** 4; **73,** 5; **74,** 6; **75,** 5; **76,** 7; **77,** 5; **78,** 6; **79,** 8; **80,** 18; **81,** 16; **82,** 11; **83,** 6; **84,** 12; **85,** **86,** 7.

See p. 1991.

Part 14, FLRR. Engineers in Charge.

Lt. Col. C. E. Blunt, 1866–69.
Maj. M. D. McAlester, 1869.
Maj. N. Bowen 1869–71.
Lt. B. D. Greene 1871.
Maj. J. M. Wilson, 1871–76.
Maj. W. McFarland, 1876–83.
Lt. Col. H. M. Robert '83–85.
Capt. E. Maguire, 1885–86.
Capt. C. F. Palfrey, 1887–89.
Maj. M. B. Adams, 1890.
Capt. D. C. Kingman, 1891–95.
Maj. W. S. Stanton, 1896–98.
Maj. T. W. Symons, 1899, 1901–1903.
Capt. G. D. Fitch, 1899–1900.
Maj. T. A. Bingham, 1904.
Lt. P. S. Bond, 1904.
Lt. Col. H. M. Adams, 1905–1907.
Lt. Col. W. L. Fisk, 1908.
Capt. W. L. Guthrie, 1909–10.
Col. J. G. Warren, 1911–12.

Part 15, FLRR. Fort Ontario, N. Y.

1839. Work begun. **80,** 19

1863–66. Replacing the timber revets. with masonry; scarp wall raised 3′; constr. flank casemates. **66,** 3.

1867. Raising scarp wall in progress; masonry of gateway postern arch, and casemates of left flank completed. **67,** 3.

1868. Raising scarp wall; masonry of 2 guardhouses completed; roof surfaces on front 4 finished and covered with mastic, and parapet of the curtain and flanks embanked. **68,** 7.

1869. Work on scarp wall. **69,** 7.

1870. Masonry of left flank commenced and completed; masonry of right flank in progress; coping laid and backed with concrete on the adjoining faces; scarp of both faces raised and minor work done. **70,** 12.

1871. Gallery in right flank of bastion E nearly completed; scarp wall of bastion E completed; building dry walls in the galleries and under the back of stairways; parapets of right and left faces sodded; terreplein graded and minor work. **71,** 7.

1872. Gallery in right flank of bastion E completed; gallery in left flank of bastion A continued; connection of gallery to proposed magazine and parapet on fronts 5 and 6 formed and sodded. **72,** 4.

1873–78. Care and preservation. **73,** 5; **74,** 6; **75,** 6; **76,** 7; **77,** 5; **78,** 7.

1879. Minor repairs. Est. cost of completion, $119,97. **79,** 9.

1880. Four penthouses built over the entrances to the flank casemates and scarp galleries of bastions D and E and entrance to unfinished gallery planked up. **80,** 19.

1881. Work in an unfinished state. **81,** 16.

1882. Work turned over to the Engineer Department for repairs. No work to be done at once. **82,** 11.

1883. New York, Ontario & Western RR. au. to lay 3 tracks across the reservation. **83,** 7.

1884. Timber revet. repaired; some minor repairs made. **84,** 12.

1885. Revet. repaired. **85,** 6.

1886. Revet. and drain ditches repaired. **86,** 7.

1902. Repairs to revets. **01,** 855; **02,** 759.

FLE. LAKE CHAMPLAIN FORTIFICATIONS.

(NOTE.—Reports on these works from 1903 to 1912 are of a general character only. See the first 15 pages of each annual report from 1903 to 1912.)

Part.	Title.	Period.
1	Engineering features	1897–1898
2	Engineers—Chief of Engineers	1866–1902
3	In charge	1866–1900
4	Forts, etc.—Fort Montgomery	1841–1902

Part 1, FLE. Engineering Features.

Prevention of percolation of water with patent granite laid in hot mastic. **97, 744.** Not satisfactory. **98, 744.**

Part 2, FLE. Engineers.

Chief of Engineers. R., 66, 3; **67,** 4; **68,** 7; **69,** 7; **70,** 12; **71,** 7; **72,** 4; **73,** 5; **74,** 6; **75,** 6; **76,** 7; **77,** 5; **78,** 7; **79,** 9; **80,** 19; **81,** 16; **82,** 11; **83,** 7; **84,** 13; **85,** 7; **86,** 7; **97,** 20, 743; **98,** 20, 773; **99,** 33, 974; **00,** 30, 973.

Part 3, FLE. Engineers in Charge.

Capt. C. B. Reese, 1866–67.
Lt. Col. C. E. Blunt, 1866–68.
Capt. J. W. Barlow, 1868–70.
Lt. Col. J. Newton, 1870–77.
Capt. J. Mercur, 1877–78.
Col. H. W. Benham, 1878–82.
Maj. W. McFarland, 1883.
Lt. Col. H. M. Robert, 1883–85.
Maj. M. B. Adams, 1885–86.
Maj. W. S. Stanton, 1897–98.
Lt. Col. A. M. Miller, 1898–99.
Col. J. W. Barlow, 1899–1900.

Part 4, FLE. Forts and Batteries—Operations—Fort Montgomery, N. Y.

1841. Work begun. **80,** 19.

1866. St. and earthen parapet and breast-height wall of the land front completed; setting parade-wall coping and turning floor arches; embanking terreplein and cover-face; constr. masonry barbette platforms (20) and excavating the moat. **66,** 3.

1867. Seventeen barbette gun platforms completed; scarp wall of the fort completed and minor work; the fort is ready for part of its armament. **67,** 4.

1868. Flagging for first and second stories of bastions C and D completed; raising s. end of parade wall; constr. revet. wall of cover-face and minor work. **68,** 7.

1869. Staircase and s. end of parade wall raised; quarters and drainage under constr.; the st. facing of w. salient of cover-face completed and minor work. **69,** 8.

1870. Completion of staircase bastion C, parade walls, asphaltic covering, and terrepleins of curtains 2 and 3; turning 4 arches of second-story floors of curtain 3 and completing earthen parapet of right flank bastion B. **70,** 12.

1871. Projs. for modification for modern guns, prepared by BE., approv. **71,** 7.

1872. Slight repairs made to magazines, retaining walls; general care of work. **72,** 4.

1873. Minor work. **73,** 5.

1875. Six shot and shell beds built on parade, and repairs made to earthen parapet, footbr. over marsh, and cavities in causeway and revet. **75,**

1876. Parade graded, br. built in main postern, causeway repaired, and parapet sodding begun **76,** 7.

1877. Earthen parapet part resodded, asphalt covering repaired, and tie rods for strengthening n. face of bastion D placed. **77,** 5.

1878. Tie rods placed on curtain 3. **78,** 7.

1879. Care and preservation. **79,** 9.

1880. Br. and wharf roadway repaired; causeway and parade raised and graded. **80,** 19.

1881. Asphalt covering of curtains 1, 2, 4, and 5, and of bastions B, C D, and E around the staircase, and wooden stair roofings, repaired; casemate doors painted and terreplein graded. **81,** 17.

1882. Repair of asphalt covering of curtains 1, 2, 3, 4, and 5; brick arches of embrasures of second tier repaired and repointed and minor repairs made. **82,** 12.

1884. Tie-rods placed in curtains 1, 3, 4, and 5, for fastening the scarp wall to the casemates to prevent leakage into magazines. **84,** 13.

1885. Wooden shutters fitted to embrasures and loophole openings, water-front sally-port gateway repaired, and interior gates placed at the land-front sally-port entrance. **85,** 7.

1886. Five center pintle and 6 front pintle platforms repaired: woodwork of br. over moat renewed. **86,** 7.

1897. 103′ of parade wall covered with patent granite roofing laid in hot mastic to prevent the percolation of water. **97,** 744.

1898-00. Care and preservation. **98,** 774; **99,** 975; **00,** 973.

1901. Mainten. work. **01,** 855; **02,** 759.

FPSS. SOUTHERN CALIFORNIA FORTIFIÇATIONS.

(NOTE.—Reports on these works from 1903 to 1912 are of a general character only. See the first 15 pages of each annual report from 1903 to 1912.)

Part.	Title.	Period.
1	Contracts	1896–1899
2	Engineering features	....
3	Engineers—Chief of Engineers	1872–1902
4	BE	1882
5	In charge	1873–1902
6	Assistants	1897–1898
7	Forts, etc. (allotments, operations, etc.)	1872–1912
8	San Diego, Cal	1872–1874
9	10-inch battery	1897–1902
10	15-pounder R. F. battery	1899–1902
11	5-inch R. F. battery	1900–1901
12	15-pounder R. F. battery, east side of bay	1901–1902
13	Miscellaneous (electric plant)	1902
14	Preservation and repair	1898–1902
15	Range and position finders	1900–1902
16	Sites	1897–1902
17	Submarine mines	1897–1900
18	Supplies	1901–1902

Part 1, FPSS. Contracts.

1896. Two 10-inch gun emplacements and a torpedo casemate, $109,417.39. **97,** 748.

1898. One 10-inch gun emplacement, $37,788.68. **98,** 778.

1899. Imported Portland cement, $2.83 per barrel. Crushed st., $1.75 per c. y. Random st., $1.90 per t. **99,** 975, 976.

Part 2, FPSS. Engineering Features.

Air spaces for dampproofing not necessary in San Diego climate. **01,** 923.

Base ring, method of leveling. **00,** 977.

Cement, testing of. **00,** 979; **02,** 2471, 2472. Briquettes, repairing with sulphur. **01,** 922.

Concretes, comparison of. **00,** 978. Ingredients. **00,** 979. Mixing of. **97,** 747; **99,** 976; **02,** 2470. Improvised plant for. **02,** 2470. Placing of. **00,** 979. Blasting through cement galleries. **02,** 2471. Cracks in; sulphur used to fill. **01,** 922 (see Cracks, below). Material of standards. **02,** 2471. Surfaces; preventing checking. **01,** 923. Wet and dry spots in; material or composition behind. **01,** 923. Sand for, character of. **02,** 2470.

Cracks, in emplacements. Asphalt used to fill. **01,** 923. (See Concrete.)

Dampness, circulation in San Diego climate to be guarded against. **01,** 923.

Floors, slopes reversed by settlement. **01,** 923.

Leaks, stopping. **01,** 922. Local treatment satisfactory. **02,** 2472.

Platforms, built as a monolith. **98,** 776.

Sand, bearing power of. **97,** 746.

Ventilating, method of. **00,** 978.

Waterproofing, method of. **00,** 978. Not necessary. **02,** 2470.

Part 3, FPSS. Engineers.

Chief of Engineers. **R.,** **72,** 24; **73,** 24; **74,** 28; **75,** 28; **76,** 29; **77,** 24; **78,** 27; **79,** 32; **80,** 51; **81,** 52; **82,** 50; **83,** 46; **84,** 52; **85,** 45; **86,** 45; **96,** 19, 528; **97,** 20, 744; **98,** 30, 775; **99,** 34, 975; **00,** 31, 974; **01,** 33; **02,** 34; **03,** 9; **04,** 5; **05,** 5; **06,** 5; **07,** 5; **08,** 9; **09,** 10; **10,** 12; **11** 8; **12,** 7.

Part 4, FPSS. Board of Engineers.

Constituted, 1882, to consider and report upon the constr. of fortifications, and what number, if any, could be dispensed with. **B., 82, 427.**

Part 5, FPSS. Engineers in Charge.

Col. C. S. Stewart, 1873–86.
Maj. C. E. L. B. Davis, 1897–99.
Capt. J. J. Meyler, 1899–1900.
Capt. Jas. J. Meyler, 1901–02.
Lt. Col. C. E. L. B. Davis, 1902.
Lt. Col. T. H. Handbury, 1902.
Capt. Edgar Jadwin, 1902.

Part 6, FPSS. Assistants.

Lt. C. L. Potter, 1897.
Lt. H. Deakyne, 1897–98.
Capt. J. J. Meyler, 1898.

Part 7, FPSS—

FORTS AND BATTERIES.

Part 8, FPSS. Fort at San Diego, Cal.

1872. Plans prepared. **72, 24.**

1873. $50,000 app. Work begun; necessary buildings erected. **73, 24.**

1874. Site cleared; 27,626 c. y. earth placed in the embankment; concrete drains built; foundation of 1 magazine laid and its walls carried up to the spring of the main arch. **74, 28.**

Part 9, FPSS. Ten-inch Battery.

1897. $115,000 allotted. Work begun under contract for 2 emplacements; wharf built. Concrete work begun; excavation work nearly completed; concrete work in progress. Methods of work. **97, 746.**

1898. $48,000 allotted for a third emplacement under contract. All work completed; guns and carriages mounted; description of work. **98, 775.**

1899. $60,000 allotted for a fourth emplacement by hired labor. Work begun. 16,000 c. y. excavated for foundations; concrete finished, waterproofing completed, and emplacement completed, except some minor work. **99, 975.**

1900. $1,100 allotted; concrete work completed: gun and carriage mounted; waterproofing magazines in progress; work nearly completed. **00, 974, 977.**

1901. Plant removed. **01, 856.**

1902. $1,400 allotted for cutting galleries through traverses of battery; plan and est. submitted for substitution of chain ammunition hoists for platform type now in use. **02, 760.**

Part 10, FPSS. Fifteen-pounder R. F. Battery.

1899. $8,865 allotted. Work begun on 2 emplacements. Excavation completed and concrete work begun and nearly completed. **99,** 978.

1900. Battery completed except 2 gun platforms awaiting the arrival of the well linings for the gun mounts. **00,** 975, 978.

1901. Blast surface constr.; platforms put in place. **01,** 856.

1902. Work delayed pending arrival of well linings. **02,** 760.

Part 11, FPSS. Five-inch R. F. Battery.

1900. $18,270 allotted. Work begun for 2 emplacements; excavation and back filling done by contract. Concrete work completed; drainage system completed. Battery completed except platform awaiting mounts. **00,** 976, 978.

1901. Gun carriages mounted: battery transferred Nov. 17, 1900. **01,** 856.

Part 12, FPSS. Fifteen-pounder R. F. Battery on East Side of Bay.

1901. $10,000 allotted. Work will begin after title to land is approv. **01,** 857.

1902. Work completed and turned over. **02,** 760.

Part 13, FPSS. Miscellaneous.

1902. Plans and est. submitted for installing electric light and power plant searchlight; proposed plan for general constr. of plant approv. **02,** 761.

Part 14, FPSS. Preservation and Repair.

1898. $720 allotted for care and general repairs **98,** 778.

1899. $1,080 allotted. General repair of buildings, fences, and grounds, etc. **99,** 979.

1900. $1,440 allotted. Electrical instruments cared for; care of property. **00,** 977.

1901. $976 allotted. Care of torpedo material and other property, repairs, painting; new ratchet wheels on elevator windlass 10-inch battery; prevention o dampness; "P. & B." paint used; survey of various grounds made. **01,** 858.

1902. $299.03 allotted for misc. repair work. **02,** 762.

Part 15, FPSS. Range and Position Finders.

1900. $2,500 allotted for battery-commander's station. Work begun; concrete work and station completed except minor work. **00,** 976, 980.

1901. Battery-commander's station completed and turned over Nov. 17, 1900. $450 allotted for constr. of 3 datum marks completed and ready for transfer. **01,** 856, 857.

1902. Adjusted; table of corrections prepared; transferred to battery. **02,** 760.

Part 16, FPSS. Sites.

1897. $2,500 allotted for purchase of site for mortar battery; $2,031.50 paid for 40.63 acres. **97**, 748.

1901. $20,500 allotted. Purchase of land. **01**, 857.

1902. Negotiations completed. **02**, 760.

Part 17, FPSS. Submarine Mines.

1897. $8,030 allotted; mining casemate being built under contract. **97**, 20, 747.

1898. Casemate completed. **98**, 776. $1,700 allotted for a cable tank; work begun in May and completed in June. **98**, 777. $7,800 allotted for mining defense; mines planted and chan. guarded by 2 Napoleon guns. **98**, 777.

1899. $2,200 allotted for additions and changes, mining casemate; work completed. **99**, 977. $4,840 allotted for a torpedo storehouse. Work begun in August and completed in April, and torpedo materials stored. **99**, 978. All mines removed from H. **99**, 979.

1900. Torpedo casemate completed and storage battery installed. **00**, 974. Wharf and tramway built near torpedo storehouse. **00**, 975 980.

Part 18, FPSS. Supplies for Seacoast Defenses.

1901. Purchase of supplies. **01**, 857.

1902. Requisitions filled. **02**, 760.

FPTT[1] UPPER CALIFORNIA FORTIFICATIONS.

(NOTE.—Reports on these works from 1903 to 1912 are of a general character only. See the first 15 pages of each annual report from 1903 to 1912.)

Part.	Title.	Period.
1	Contracts	1901–1902
2	Engineering features	....
3	Engineers—Chief of Engineers	1866–1902
4	BE	1882–1889
5	In charge	1866–1902
6	Assistants	1891–1904
7	Forts, etc. (allotments, operations, etc.)	1853–1912
8	Fort Winfield Scott	1853–1886
9	Fort Point	1853–1882
10	Fort Mason	1883
11	Battery at Point Jose	1866–1880
12	Angel Isld	1870–1880
13	Alcatraz Isld	1866–1885
14	Lime Point	1866–1882
15	Point Lobos	1866
16	South side of B.—Emplacements 9, 10, 11, 12, 13, for 10-inch rifles, disappearing carriages	1891–1900
17	Emplacements 14, 15, 16, 18, and 19, for 12-inch rifles on barbette carriages	1892–1900
18	Mortar battery No. 2	1893–1902
19	Pneumatic dynamite gun battery	1896–1901
20	Emplacement 8, for 12-inch nondisappearing carriages	1897–1899
21	Mortar battery No. 2	1897–1900
22	Two emplacements, 5-inch R. F. guns, balanced pillar mounts	1898–1902
23	Three emplacements, 8-inch rifles, disappearing carriages	1899–1900
24	Emplacement for 8-inch gun, disappearing carriage	1899–1901
25	Emplacement for 12-inch gun, nondisappearing carriage	1901–1902
26	Emplacements, three 15-pounder R. F. guns	1901–1902
27	Emplacement for 5-inch R. F. gun, balanced pillar mount	1899–1902
28	Emplacements, two 6-inch guns, disappearing carriages	1899–1901
29	Emplacements 6 and 7, for 12-inch rifles, disappearing carriages	1899–1900
30	Emplacements, two 5-inch R. F. wire-wound guns	1900–1901
31	Emplacements, two 15-pounder R. F. guns	1900–1902
32	Emplacements, two 12-inch guns, disappearing carriages	1900–1902
33	Emplacements, sixteen 12-inch mortars	1900–1902
34	North side of B.—Emplacements, three 12-inch rifles, disappearing carriages	1894–1900
35	6-inch R. F. guns	1902
36	Two emplacements, 3-inch R. F. guns	1902
37	Emplacements, two 12-inch guns, disappearing carriages, and eight 12-inch mortars	1901–1902
38	Two emplacements, 8-inch B. L. rifles, nondisappearing carriages	1898–1900
39	Emplacements, two 12-inch guns, disappearing carriages	1899–1901
40	Emplacements, two 5-inch R. F. guns, balanced pillar mounts	1899–1901
41	Platforms, four 8-inch rifles	1897–1898
42	Ten platforms, 8-inch converted rifles and service magazine	1898–1900
43	Two 6-inch guns, Ordnance Department mounts	1901
44	Island in H. (San Francisco)—Emplacement, one 8-inch B. L. rifle, nondisappearing carriage	1898–1900
45	Emplacement, one 8-inch gun, disappearing carriage	1899–1901
46	Emplacements, two 5-inch R. F. wire-wound guns	1900–1901
47	Miscellaneous (Electric plant; Firing of ordnance; Engineer buildings; Searchlight; Magazine; Projector; Lockers; Steam vessel; Racks)	1899–1902
48	Preservation and repair	1897–1902
49	Range and position finders	1898–1902
50	Sea walls	1868–1870
51	Sites	1892–1902
52	Mines	1891–1902
53	Supplies	1900–1901
54	Surveys	1866–1868

[1] Usually in charge of Second San Francisco, Cal., U. S. Engineer Office.

Part 1, FPTT. Contracts.

1901. Constr. steam vessel, $20,000; supplemental work, $150. 01, 894.

1902. Electric-lighting plant, $2,190; moving six 12-inch mortar carriages and base rings, $3.375; moving two 12-inch gun carriages and base rings, $2,500. 02, 781.

Part 2, FPTT. Engineering Features.

Air space, description of. **99**, 982.

Asphalt, composition of. **96**, 534, 535; **99**, 982; **00**, 982, 1013.

Aprons, concrete; description of. **96**, 534, 535.

Bolt, anchor; setting. **96**, 536.

Concrete, cost per c. y. **93**, 621; **94**, 465; **96**, 528, 530; **97**, 754; **98**, 788, 793; **00**, 987, 994. Ingredients of. **93**, 620; **99**, 987; **00**, 982, 988. Mixing. **93**, 620; **99**, 987; **00**, 982, 990, 1009; **02**, 2473. Placing. **00**, 1003. Plant. **03**, 2418. Settlement of. **99**, 985.

Cracks in retaining walls. **99**, 982, 985; **00**, 990, 1012, 1013.

Dampproofing. **99**, 957, 969; **00**, 982; **02**, 2473, 2474.

Drainage. **02**, 2474.

Entrance, of battery. **04**, 3738 (pl.).

Foundations. **03**, 2417.

Ironwork, cleaning and painting. **03**, 2419.

Materials, cost of. **93**, 620; **94**, 465; **96**, 529, 537; **97**, 967; **00**, 987, 994.

Mixer, gravity, description of. **00**, 1009.

Mortars, firing. **97**, 753.

Ordnance, transporting. **03**, 2422 (pl.).

Parapet and traverse, method of building. **00**, 989.

Plant, electric light and power; description of. **00**, 991, 1007. Description of. **93**, 620; **00**, 989, 993; **02**, 2472.

Railroad and cars. **04**, 3738 (pl.).

Reservoirs. **04**, 3738 (pl.).

Roads; details. **04**, 3733 (pl.), 3738

Roofs; details. **03**, 2419, 2420.

Sand blast. **03**, 2420.

Surfaces, concrete, finishing. **96**, 536.

Tile, placing. **00**, 982.

Ventilation. **04**, 3738 (pl.).

Walls, coating. **03**, 2420. Construction. **03**, 2419.

Waterproofing, various methods. **03**, 2420, 2421; **04**, 3737, 3738 (pl.).

Water supply, cisterns, etc. **04**, 3738.

Water-supply system. **00**, 993.

Whitewash for walls and ceilings of rooms and passages, composition of. **99**, 987.

Part 3, FPTT. Engineers.

Chief of Engineers. **R.**, **66**, 17; **67**, 14; **68**, 19; **69**, 19; **70**, 26; **71**, 24; **72**, 22; **73**, 23; **74**, 27; **75**, 26; **76**, 28; **77**, 23; **78**, 26; **79**, 31; **80**, 52; **81**, 52; **82**, 51; **83**, 47; **84**, 52; **85**, 45; **86**, 45; **90**, 4; **91**, 6, 8; **92**, 8; **93**, 9; **94**, 10; **95**, 11, 515; **96**, 19, 528, 530; **97**, 20. 744, 748; **98**, 8, 30, 779; **99**, 35 980; **00**, 32, 980; **01**, 33; **02**, 34; **03**, 9; **04**, 5; **05**, 5; **06**, 5; **07**, 5; **08**, 9; **09**, 10; **10**, 12; **11**, 8; **12**, 7.

Part 4, FPTT. Board of Engineers.

Constituted, 1882, to consider and report upon the constr. of fortifications, and what number, if any, could be dispensed with. **R.**, **82**, 427.

Ests. 1881 **87**, **11**.

Ests., 1889. **89**, **6**.

Part 5, FPTT. Engineers in Charge.

Col. R. E. de Russey, 1866.

Maj. G. H. Elliot, 1866–70.

Lt. Col. G. H. Mendell, 1867–86.

Col. C. S. Stewart, 1870–86.

Col. G H. Mendell, 1891–96. **R.**, **93**, 619; **94**, 465.

Lt. Col. W. H. H. Benyaurd, 1893–96. **R.**, **93**, 623.

Lt. C. L. Potter, 1896.

Maj. C. E. L. B. Davis, 1896–1900.

Capt. J. E. Kuhn, 1896.

Maj. W. H. Heuer, 1898–1900.

Col. S. M. Mansfield, 1899.

Lt. Col. C. E. L. B. Davis, 1901–02.

Lt. Col. Thos. H. Handbury 1902.

Part 6, FPTT. Assistants.

Lt. H. C. Newcomer, 1891-92.
Lt. C. L. Potter, 1891-97.
Lt. C. A. F. Flagler, 1893-95.
Capt. J. E. Kuhn, 1895-98.
Capt. H. Deakyne, 1896-1900.
Lt. H. C. Wolf, 1898-99. R., 98, 787, 794.
Lt. L. M. L. Walker, 1898.
Capt. F. R. Shunk, 1898-99.
Lt. W. Kelly, 1899-1900.
Lt. Geo. B. Pillsbury, 1901.

Part 7, FPTT—

FORTS AND BATTERIES.

Part 8, FPTT. Fort Winfield Scott.

1853. Work begun. **83,** 47.

1870. Exterior earthen batteries begun. **83,** 47.

1883-86. General repairs for preservation. **83,** 47; **84,** 53; **85,** 45; **86,** 45.

Part 9, FPTT. Fort at Fort Point.

1853. Work begun. **53,** 52.

1866. Ironwork cleaned and painted; drainage repaired; some work on sea wall. **66,** 17.

1867. Work on painting ironwork, drainage, sea wall; excavation for w. casemated battery; excavation for sea wall begun; heavy cofferdam built for a distance of 350′ along the shore; buildings removed from site of new battery; wharf extended and repaired. **67,** 14.

1868. RR. completed; coping of old wall extended 126′; cofferdam for protection of site of new sea wall completed. **68,** 19.

1869. Repair of quarters; minor work on sea walls, etc. **69,** 19.

1870. Importance of fort. General repair of quarters. Modification plans prepared. **70,** 26.

1871. $50,000 app. Work begun on batteries to the s. of fort; 29,586 c. y. embankment placed; 7,180 sq. y. slope sodded. Work on breast-height wall and traverse magazines; 1,928 c. y masonry placed. Repair of wharf, buildings, etc. **71,** 24.

1872. $85,000 app. Work on breast-height wall; 8 front-pintle st. platforms placed, and the masonry of 12 others completed; 2 traverse magazines built, 10 others finished; 1,324 l. f. of earthwork of barbette batteries completed; magazine doors made and hung and minor work. **72,** 22.

1873. $65,000 app. 830 l. f. of parapet of barbette and mortar batteries nearly completed; 6 magazines built and work on 3 others and on embankments; 11 pintles and sets of traverse rails placed for heavy guns; 8 platforms for heavy mortars placed and minor work. **73,** 23.

1874. $30,000 app. Four service magazines built; work on concrete foundation for 8 platforms for heavy guns; pintles and rails placed on 2 platforms for 15-inch guns and 4 platforms for heavy mortars built. Work on embankment; asphalt floors placed in 11 traverse magazines; wharf rebuilt; minor work. **74,** 27.

1875. $25,000 app. Work on 1 service magazine; breast-height walls for 8 heavy guns completed; 8 pintle blocks placed as well as concrete foundations for 12 platforms for heavy guns; 9,443 c. y. earth embanked in parapets and traverses, and 6,743 sq. y. sodding placed on slopes; minor work. **75,** 26.

1876. Breast-height wall for 6 heavy guns completed and concrete foundations for 2 heavy gun platforms placed. 8,365 c. y. earth embanked in parapets and traverses and 3,777 sq. y. sodding placed on slopes; doors completed and hung in 7 traverse magazines; minor work. **76,** 28.

1877-79. Care and preservation. **77,** 23; **78,** 26; **79,** 31.

1880. History and importance of fort. **80,** 52.

1881. Repair of quarters, slopes, etc. **81,** 52.

1882. Condition of works. **82,** 51.

Part 10, FPTT. Fort Mason.

1883. Two temporary earthen batteries built during the Civil War. **83, 49.**

Part 11, FPTT. Battery at Point José.

1866–70. Modification plan submitted. **66,** 18; **70,** 27.

1870. Three 5-inch Rodman guns brought to the rear of battery. **70, 23.**

1880. History of battery. Timber magazine in earthen battery rebuilt and 3 timber platforms replaced for purposes of drill and practice firing **80, 53.**

Part 12, FPTT. Batteries on Angel Island.

1870. Modification plans prepared. **70, 28.**

1880. History and importance of batteries. **80, 53.**

Part 13, FPTT. Fort on Alcatraz Island.

1866. Work on new bombproof barrack; new ramp built from guardhouse to summit of isld.; new wharf built; old platforms removed; minor work. **66,** 18.

1867. Work on new barrack; r. excavation made for extension of Battery Rosecranz. Resurvey of isld. in progress. **67,** 15.

1868. Wharf extended; a number of permanent center pintle platforms adopted for 8-inch and 10-inch guns; work on new barrack. **68,** 20.

1869. 4,000 c. y. r. excavated and thrown over the scarp walls; repair of buildings, etc. **69,** 10.

1870. Importance of fort. Modification plans prepared. 18,000 c. y. r. excavated for foundations and work begun converting gun rooms into a magazine traverse. **70,** 27.

1871. $75,000 app. Gun platforms in batteries 1 and 4 removed; 3 service magazines in battery 2 completed; 1 service magazine built in battery 3, and breast-height wall for 2 guns begun; excavation for foundation of battery 5. **70,** 25.

1872. $42,500 app. Battery 4—breast-height wall for 2 guns built, parapets made and sodded, magazine completed; 3 magazines in battery 2 covered and sodded; work on large magazine. Battery 5—2 granite platforms for 15-inch guns with circular breast-height walls built and sodded; service magazine nearly completed; minor work. **72,** 23.

1873. $50,000 app. N. caponiere completed, covered, and sodded; 6 magazines and 3 shell rooms built; work on retaining walls and parapets for guns; excavations for batteries 5 and 6 completed. Filling in mortar battery begun; minor work. **73, 24.**

1874. $20,000 app. S. caponiere partly remodeled, 2 magazines with bombproofs built, breast-height walls for 2 guns built, and 2 st. platforms laid; parapets for 4 guns made; 6,300 sq. y. sodding laid on parapets, magazines, and slopes; wood revet. in rear of wharf replaced with a substantial st. wall laid in mortar; work on retaining wall. **74, 28.**

1875. $25,000 app. 469 c. y. masonry placed in magazine; 2,250 sq. y. sod placed on slopes; 36,930 c. y. excavation made, minor work. **75,** 27.

1876. Two magazines and 2 bombproofs built; 3 adjacent wings of the breast-height wall built; 2 drains extended and wharf repaired. **76,** 28.

1877. 5,368 c. y. excavated for parade ground by the prisoners. Magazine P covered with earth, its floor asphalted, and gutters in passageway concreted. **77,** 23.

1878. Care and preservation. **78,** 27.

1879. Wharf painted; general repairs of buildings. **79,** 31.

1880. History and importance of fort. **80, 53**

1882–83. General repairs. **82,** 53; **83, 49.**

1885. Two st. platforms completed. **85, 47**

Part 14, FPTT. Fort at Lime Point.

1866. Title approv. and land bought. 66, 18.

1867. Work begun; excavation for foundation in progress. 67, 15.

1868. Necessary buildings erected; water supply for fire purposes installed; fence and wharf built; SS. built for service on the work; 60,000 c. y. r. excavated and a tunnel 60′ long excavated for a large blast. 68, 20.

1869. 90,000 t. of r. removed by 2 blasts; work of excavating for foundations completed; fence completed. 69, 19.

1870. Importance of fort. Proj. 70, 27.

1871. $100,000 app. Wagon road built; 4 magazines in Gravelly Beach battery completed; excavation for batteries on the cliffs; minor work. 71, 24.

1872. $75,000 app. Gravelly Beach battery—2 magazines completed, 6 covered with earth and sodded, a breast-high timber revet. placed and concrete foundations for guns put in. Lime Point Ridge—breast-high walls for 4 front and 5 center-pintle guns built of masonry; 4 magazines built, covered with earth, and sodded; 4 st. platforms for front-pintle 15-inch carriages completed; parapets for 9 guns and 6 mortars finished and 3 mortar platforms made and placed. Point Cavallo battery—work on roadway and excavation. 72, 22.

1873. $160,000 app. Gravelly Beach battery—12 wooden platforms placed and battery nearly completed; three 13-inch mortar platforms placed in the Ridge battery. Point Cavallo battery—5 magazines built and work on 6 others; parapets and terreplein. 73, 23.

1874. $30,000 app. Point Cavallo work nearly completed. Gravelly Beach parapets and traverses repaired; new road, 4,200 l. f., completed near Point Diablo. 74, 27.

1875. $20,000 app. 5,950 l. f. of road built to site of batteries near Point Diablo; gun battery in advance at Point Cavallo completed except gun platforms; 8 breast-high walls laid in Point Cavallo battery; minor work. 75, 27.

1876. Hoods placed on traverses at Point Cavallo battery; 4,000 c. y earth and 2,535 sq. y. sodding placed. Repairs at the Ridge and Gravelly Beach batteries. 76, 28.

1877. Property in charge of fort keepers. 77, 23.

1880. History and importance of the fort. 80, 52.

1882. Condition of works. 82, 52.

Part 15, FPTT. Point Lobos.

1866. Topographical survey made. 66, 18.

Part 16, FPTT. South Side of Bay—Emplacements 9, 10, 11, 12, and 13, for 10-inch Rifles on Disappearing Carriages.

1891. Work begun on excavation. 91, 8.

1892. Excavation completed and concrete work in progress. 92, 8.

1893. Concrete work completed; awaiting details of carriages to be used. Work described. 93, 619.

1894. Top surfaces of magazines plastered and painted with waterproof paint. Roadway being built. 94, 10.

1895. Details of carriages received and concrete work in progress on platforms. 95, 516.

1896. Parapets and magazines completed and 3 inches asphalt covering placed; 3 platforms completed 1.319 c. y. concrete placed ammunition service installed 2 guns and carriages received; mounting was begun but stopped to alter carriages. Itemized cost of work. 96, 535.

1897. Two guns mounted in emplacements 11 and 12. Work in progress; mounting gun in emplacement 13. $57,000 allotted for emplacements 9 and 10. Work begun in June, excavation completed and some concrete work done; itemized cost of work. 97, 749, 755.

1898. Concrete work of emplacements 9 and 10 completed; machinery installed and guns and carriages mounted; guard and relocator room built; itemized cost of work. 98, 779, 788.

1900. Steps at emplacements 11 and 12 repaired. 00, 988.

Part 17, FPTT. South Side of Bay—Emplacements 14, 15, 16, 18, and 19, for 12-inch Rifles on Barbette Carriages.

1892. Work begun on emplacements 14, 15, and 16; excavation completed and concrete work in progress. **92,** 8.

1893. Concrete work completed; awaiting details of carriages to be used. Work described. **93,** 619.

1894. Top surfaces of magazines plastered and painted with a waterproof paint. Roadway being built. **94,** 10.

1895. Details of carriages received. One emplacement completed, RR. iron and cable placed in concrete, gun mounted, and work in progress on another. **95,** 11, 515.

1896. Parapets, aprons, and magazines of 3 emplacements completed and covered with a 3-inch layer of asphalt. Gun fired 17 times to test asphalt covering. Two other platforms built, RR. iron and cable placed in concrete and 1 gun mounted. Ammunition service installed and all engineering work of the 12-inch emplacement completed, except setting base ring in 1 emplacement; carriage not yet received; itemized cost of work. **96,** 533, 564.

1897. Work begun on emplacements 18 and 19 in November, 1896; concrete work completed; 4,576 c. y. placed; all machinery installed; 1 gun mounted in emplacement 18. Itemized cost of work. **97,** 749, 754.

1898. Guard and relocator room emplacement 14 completed; itemized cost. Minor work completed. Gun mounted in emplacement 19 and the completed battery turned over to the troops. Itemized cost of work for emplacements 18 and 19. **98,** 780, 791.

1900. Latrine built; description and itemized cost. **00,** 988.

Part 18, FPTT. South Side of Bay—Mortar Battery No. 1.

1893. Work begun Apr. 5, 1893; 10,781 c. y. excavated for foundation, completing same; 528 c. y. concrete placed; drainage in progress; conduit for electric-firing wires laid in floor. **93,** 622.

1894. 32,324 c. y. earth excavated; 7,097 c. y. concrete and 44,124 c. y. filling placed. Two platforms laid in granite; electric-light system installed; minor work. **94,** 11, 465.

1895. All concrete work completed; slopes sodded and seeded; 16 mortars mounted; firing cable installed; picket fence built around the battery; battery completed except ammunition conveyors. **95,** 11, 516.

1897. Ammunition conveyors, etc., being installed; a new firing room built and a new firing circuit installed. **97,** 748, 753.

1898. Relocator room built; speaking tubes installed; cost of work. **98,** 788.

1901. $5,233 allotted. Changing azimuth circles and completing battery; steam drill purchased. **01,** 875.

1902. Work continued; circles placed by Ordnance Department; excavation concrete used to repair roads in vicinity of battery; itemized statement of cost given. Constr. of latrine; details given. **02,** 770, 771.

Part 19, FPTT. South Side of Bay—Pneumatic Dynamite Gun Battery.

1896. Three 15-inch guns mounted; compressor plant in place. No form of protection undertaken. **96,** 533.

1899. $150,000 app. High earthen traverse built nearly around power house, kept in place by a high concrete retaining wall; wall badly cracked; 120,000 c. y. back filling placed; work in progress. **99,** 981.

1900. Magazines and traverses completed, built of 90,000 c. y. of sand; seven 1½-inch iron rods, each 120′ long, were driven through the sand to the rear walls of the gun pits, thus tying the retaining wall to the rear walls of the gun pits. Completed battery turned over to the Artillery. Description of placing sand and of making slopes. **00,** 989.

1901. Alterations made to switchboard, electric plant. **01,** 875.

Part 20, FPTT. South Side of Bay—Emplacement 8, for 12-inch Non-disappearing Carriages.

1897. Work begun in October, 1896; concrete work completed; 4,257 c. y. placed. Machinery installed and emplacement nearly completed. Itemized cost of work. **97,** 749, 754.

1898. Machinery installed and minor work done; cost; carriage not yet received. **98,** 780, 789.

1899. Gun and carriage mounted and emplacement turned over to the Artillery June 15, 1899. **99,** 981.

Part 21, FPTT. South Side of Bay—Mortar Battery No. 2.

1897 $108,000 allotted. Work begun in June: site cleared. **97**, 750, 755.

1898. 43,500 c. y. excavated; 45,850 c. y. back fill and 9,920 c. y. concrete placed· carriages mounted. Battery completed except installing electric plant and mounting mortars; itemized cost of work. **98**, 779, 793.

1899. Mounting mortars completed. **99**, 981.

1900. Electric-light plant to be installed. **00**, 981.

Part 22, FPTT. South Side of Bay—Two Emplacements for 5-inch R. F. Guns on Balanced Pillar Mounts.

1898. Work begun March 16; excavation completed and concrete work in progress· work delayed; cylinders to pivot the guns not on hand; concrete work on relocator and entrance to old magazine completed; itemized cost of work. **98**, 780, 781, 791.

1901. $7,700 allotted. Cylinders arrived; forms erected; concreting completed; battery allowed to dry; rooms whitewashed; electric wiring put in. **01**, 875.

1902. Battery transferred; carriages mounted; guns not received. **02**, 770.

Part 23, FPTT. South Side of Bay—Three Emplacements for 8-inch Rifles on Disappearing Carriages.

1899. $67,000 allotted. Work begun and completed except the magazine doors, electric lights, and minor work. Air space formed in 1 emplacement by placing hollow partition tile around the magazine. Dampproof course laid over the magazine. **99**, 982.

1900. $8,000 allotted. Magazine doors placed. trolleys installed, electric-light plant installed, guns mounted, and battery turned over to the Artillery. All concrete surfaces exposed to view from the H. were painted with paraffin paint to conceal them. **00**, 987.

Part 24, FPTT. South Side of Bay—Emplacement for 8-inch Gun on Disappearing Carriage.

1899. $28,700 allotted. Work begun in February and completed except electric plant, ammunition hoist, and minor work. **99**, 983.

1900. $4,000 allotted. Fence built around battery; trolleys installed; electric-light plant installed by contract; speaking-tube connections made with emplacements for 8-inch converted rifles and the relocator room. Ammunition hoists and base ring still to be set in place. Description of excavation work, concrete mixing, tile placing, and cement finishing, with itemized cost of all work. **00**, 981.

1901. Ammunition hoist set; Artillery mounted gun; other misc. work; battery transferred August 1900. **01**, 873.

Part 25, FPTT. South Side of Bay—Emplacement for One 12-inch Gun on Non-disappearing Carriage.

1901. $60,000 allotted. Plans and est. approv. No work done. **01**, 876.

1902. Excavation and concrete work in progress. **02**, 771. Drainage, ventilation, ammunition service, electric-light plant, minor accessories, etc., done; detailed statement of work and cost given. **02**, 773. Battery is entirely completed except setting base rings of carriage, which have not yet been received. **02**, 774.

Part 26, FPTT. South Side of Bay—Emplacements for Three 15-pounder R. F. Guns.

1901. $15,200 allotted. Nothing done. **01,** 886.

1902. Excavation and concrete work in progress; details given. Minor accessories supplied; refill made; slopes covered with loam; macadamized road made; itemized cost given. **02,** 769.

Part 27, FPTT. South Side of Bay—One Emplacement for a 5-inch R. F. Gun on Balanced Pillar Mount.

1899. $6,000 allotted. Materials purchased. **99,** 981.

1900. Work begun, excavation completed, road prepared, and the loam placed on slopes for a top dressing. Work suspended, awaiting the arrival of ironwork of the balanced pillar mount. **00,** 988.

1901. Cylinder arrived; work carried on same as 2 other 5-inch emplacements. **01,** 875.

1902. Battery transferred; carriages mounted; guns not received. **02,** 770.

Part 28, FPTT. South Side of Bay—Emplacements for Two 6-inch Guns on Disappearing Carriages (Part of the Heavy R. F. Armament).

1899. $56,000 allotted. Work begun on excavation. **99,** 981.

1900. $3,050 transferred from other works. Excavation completed: new water-supply system installed; concrete work in October; battery entirely completed by June; no guns on hand; description of mixing concrete. **00,** 990.

1901. Transferred to Artillery; carriages mounted; guns not received. **01,** 875.

Part 29, FPTT. South Side of Bay—Emplacements 6 and 7, for 12-inch Rifles on Disappearing Carriages.

1899. $75,500 allotted. Work begun in September, 1898, and practically completed in the spring of 1899. Guns and carriages not received. **99,** 981.

1900. Floor of dynamo room laid, aprons built, base rings set; battery entirely completed in November and turned over to the Artillery, who mounted the guns. **00,** 988.

Part 30, FPTT. South Side of Bay—Emplacements for Two 5-inch R. F. Wire-Wound Guns.

1900. $17,473 allotted and $3,600 transferred from other allotments. Work begun in January; platform built spearate from magazines. Battery completed except setting base rings, not received. whitewashing the rooms. **00,** 987.

1901. Whitewashing rooms; name plates for speaking tubes put in place; battery transferred August, 1900. **01,** 873.

Part 31, FPTT. South Side of Bay—Emplacements for Two 15-pounder R. F. Guns.

1900. Site selected and plans and ests. prepared fo 2 emplacements on balanced pillar mounts **00,** 988.

1901. $12,000 allotted. Plant erected; work begun and practically completed. **01,** 874.

1902. Work in progress. **02,** 769.

Part 32, FPTT. South Side of Bay—Emplacements for Two 12-inch Guns on Disappearing Carriages.

1900. $114,000 allotted. Work begun in September, 1899. Necessary buildings erected; excavation and roadway completed; water-supply system installed; about 35 acres of the barren sand dunes planted with bunch grass (Arundinario); 4,000 young eucalyptus trees bought and planted. Concrete work begun in February and completed in March; electric-light plant installed; ammunition hoists and trolleys erected and all work completed except setting base rings; base rings to arrive. Description of excavation work, erection of plant, mixing concrete, water-supply system, placing sod and planting trees on the sand dunes, placing tiling, with complete itemized cost of all work. **00,** 992.

1901. Ammunition hoists installed; battery painted; work to prevent leaking. Base rings to be set. **01,** 875.

1902. Ironwork painted; carriage No. 26 received; base ring set. **02,** 771.

Part 33, FPTT. South Side of Bay—Emplacements for Sixteen 12-inch Mortars.

1900. $175,000 allotted. Work begun Nov. 27 1899. Excavation completed; 68,300 c. y. removed; concrete work begun and 8 platforms finished. Sewers and drains laid. Description of excavation work and of placing concrete. **00,** 1002.

1901. Floors and foundations completed; concrete work in progress and practically completed; installation of plumbing, electric light, trolleys, etc.; a windmill and tank erected; 6 mortar carriages received and mounting carried on by Artillery; engineering work completed except setting 10 base rings and grates for fireplaces. Detailed statement of work and cost given. **01,** 876, 878.

1902. Grates for fireplaces installed; 11 base rings set; 1 mortar received and mounted by the Artillery. **02,** 774.

Part 34, FPTT. North Side of Bay—Emplacements for Three 12-inch Rifles on Non-disappearing Carriages.

1894. $72,000 allotted, 1892. Work begun in February for 2 emplacements; concrete work completed as far as contemplated and 4 inches of asphaltum placed on top of the emplacements; magazine doors made and hung; minor work. **94,** 11.

1895. $36,761.29 allotted. 4,870 c. y. loose r. excavated for another emplacement; concrete work in progress. **95,** 12.

1896. $8,400 allotted for 3 gun platforms; 1 completed and work on the other 2 in progress. Itemized cost of work. **96,** 528.

1897. Ammunition service installed; 2 guns and carriages mounted; work on the other gun and carriage. Mounting of guns and carriages done by the Artillery. **97,** 744.

1898. Battery completed; 3 guns and carriages mounted; battery and covered way leading back to the main road surrounded with barbed-wire entanglements and a stockade built across the end of the covered way. **98,** 780.

1900. Slight alteration of trucks of ammunition service. Waterproofing magazines in progress; previous work unsuccessful. **00,** 1011.

Part 35, FPTT. North Side of Bay—Four Emplacements for 6-inch R. F. Guns.

1902. $54,409 allotted. Road built excavation about 25% done. **02,** 765.

Part 36, FPTT. North Side of Bay—Two Emplacements for 3-inch R. F. Guns.

1902. $16,787.70 allotted Work begun; excavation 60% done. **02,** 765.

Part 37, FPTT. North Side of Bay—Emplacements for Two 12-inch Guns of Disappearing Carriages and for Eight 12-inch Mortars.

1901. Sites selected; tramway and wharf built; details of work and physical conditions at this battery given; $122,210 allotted for disappearing guns; $106,867 allotted for mortars; $14,466 allotted for wharf and tramway. **01,** 863.

1902. $9,490 allotted for two 12-inch disappearing guns; excavation completed; concrete work in progress; gun carriages with base rings received; detailed statement of work given. **02,** 763. Eight 12-inch mortars; excavation work in progress. **02,** 763. Road built connecting batteries. **02,** 764. Transportation of mortar carriages completed. **02,** 764.

Part 38, FPTT. North Side of Bay—Two Emplacements for 8-inch B. L. Rifles, Non-disappearing Carriages.

1898. $55,000 allotted. Work begun April 9, and the work nearly completed; awaiting arrival of carriages. **98,** 781.

1899. $3,000 allotted. Total of 17,885 c. y. excavation and 2 700 c. y. concrete placed; electric-light plant and ammunition service installed; walls and ceiling whitewashed; reservoir, capacity of 10,000 gallons, built; minor work; no carriages received. Itemized cost of work. **99,** 986.

1900. $1,505 allotted. Guns and carriages received and moved from wharf to site of battery under contract; base rings set and battery turned over to the Artillery May 5, 1900. **00,** 1011.

Part 39, FPTT. North Side of Bay—Emplacements for Two 12-inch Guns on Disappearing Carriages.

1899. $67,000 allotted. Work begun. Owing to the peculiarly sheltered position of this battery provision had only to be made against direct penetration and all concrete surfaces were so shaped as to deflect any impinging shot. Work delayed, awaiting settlement of concrete. Old flat traverse irons distributed through the concrete to resist the effect of unequal settlement. **99,** 985.

1900. $8,000 allotted and $3,913 transferred from other works. All cracks in concrete repaired and asphalt laid on upper surfaces of the concrete covering of the rooms; electric plant installed and tested. Carriages moved from landing to site of battery under contract; base rings set in June. Summary and itemized cost of battery. **00,** 1013.

1901. Guns mounted; turned over to Artillery. **01,** 862.

Part 40, FPTT. North Side of Bay—Emplacements for Two 5-inch R. F. Guns on Balanced Pillar Mounts.

1899. $25,000 allotted. Work begun on excavation, making roadway, storing the necessary gravel and sand obtained from the beach. **99,** 986.

1900. Excavation completed, foundations and drains laid, road to site of battery built, and materials for concrete work stored. Work suspended, awaiting arrival of ironwork of the balanced pillar mounts. **00,** 1012.

1901. Engineer work on battery completed; au. given by Chief of Engineers to mount carriages: Artillery troops to do same. Itemized statement of work given. **01,** 860.

Part 41, FPTT. Platforms for Four 8-inch Rifles.

1897. $1,400 allotted. Four platforms for converted rifles nearly finished. **97,** 750.

1898. Four platforms for 8-inch converted rifles completed and armed. **98,** 786.

Part 42, FPTT. Ten Platforms for 8-inch Converted Rifles and One Service Magazine.

1898. $3,700 allotted. Three built on n. side of B. and 3 on an isld. in the B. Old timber magazine on the isld. repaired. **98**, 786.

1899. Two guns and carriages mounted, in good condition; 2 mounted on practice platforms; 6 guns and carriages received but not mounted. **99**, 990.

1900. Three emplacements on an isld. in the B. All armament removed to make way for permanent R. F. gun emplacement. **00**, 1008.

Part 43, FPTT. Two 6-inch Guns on Ordnance Department Mounts.

1901. $30,000 allotted (withdrawn). Preparation of plans in progress. **01**, 893.

Part 44, FPTT. Island in Harbor—Emplacement for One 8-inch B. L. Rifle on Non-disappearing Carriage.

1898. $31,000 allotted. Work begun April 1; necessary buildings erected; excavation completed; 2,300 c. y. concrete placed; on June 20 the entire work was completed, awaiting arrival of carriage. Itemized cost of work. **98**, 781, 794.

1899. $2,000 allotted. Electric-light plant installed; no base ring received. **99**, 989.

1900. $500 allotted. Carriage received; minor repairs of concrete of lookout, latrine, and wooden steps; gun mounted; emplacement transferred to the Artillery on May 1, 1900. **00**, 1006.

Part 45, FPTT. Island in Harbor—Emplacement for One 8-inch Gun on Disappearing Carriage.

1899. $36,000 allotted. **99**, 988.

1900. $2,100 allotted and $3,492.70 transferred from other allotments. Work begun in July, 1899. As the site of the battery was occupied by a reservoir of 150,000 gallons capacity, a new reservoir had to be built; tank completed. All st. was received from a quarry on Angel Isld. and crushed for use. Concrete work completed; about 2,000 c. y. placed; electric-light system and ammunition service installed and battery completed, except placing the base ring, not received. Description of work, with itemized cost. **00**, 1006.

1901. Base ring set; work completed; transferred to Artillery August, 1900. **01**, 871.

Part 46, FPTT. Island in Harbor—Emplacements for Two 5-inch R. F. Wire-Wound Guns.

1900. $20,093 allotted. Battery site occupied by 3 emplacements for 8-inch converted rifles; rifles and carriages on hand but not mounted also 10 old cannon. These were removed by the Artillery. Work begun January 27 on excavation. 5,310 c. y. removed: 1,296 c. y. concrete placed. No large st. was placed in roofs of magazines. Concrete retaining wall built to the left and slightly in front of gun No. 2, to prevent further disintegration of the original bank. All machinery installed and work completed, except whitewashing the interior walls. Emplacements ready for guns. Description of work with itemized cost. **00**, 1008.

1901. Walls whitewashed; batteries transferred. **01**, 871.

Part 47, FPTT. Miscellaneous.

Electric plant. **1899.** $13,300 allotted and $2,719.74 transferred from other works. Plans prepared. **99,** 982.

1900. Emplacements 6 to 19, inclusive, to be divided into 3 groups, with a dynamo room and switchboard complete for each group. All work completed under contract for $8,814. Description of dynamos. **00,** 991.

1901. $1,108.78 allotted. Additional instruments on boards and switchboard at mortar battery No. 1: repairs to wiring. **01,** 885.

1902. $375 allotted. Electric connections made at emplacements 6 and 7; itemized statement of cost given. **02,** 775.

Electric-light and power plant. **1901.** $23,595 allotted. Remarks relative to constr. of this plant. **01,** 868.

Firing of ordnance. **1901.** List of shots fired from batteries on n. side of H. **01,** 869. List of shots fired by Ordnance Department on s. side of H. **01,** 887.

Engineer buildings. **1901.** $6,451 allotted. New buildings for quarters for workmen and teams under way. **01,** 868.

1902. $181.95 allotted. Buildings completed. **02,** 764.

Installation of searchlight. **1901.** $2,515 allotted for constr. br. power house for oil engine and corrugated iron shelter for a 30-inch searchlight; work completed. **01,** 884. Proj. prepared for installation of 25 lights; est., $127,205.61. **01,** 893.

Peace storage magazine. **1901.** Ests. for constr. of peace storage magazine in this district, respectively, $7,665.58, $6,511.16, $10,316.97, $7,554.43. **01,** 893.

Power house and shelter for projector. **1901.** Building erected; work completed; itemized statement given. **01,** 862.

Shelf lockers for dynamo rooms. **1901.** Constr. of 8 shelf lockers for tools and cleaning material; work completed. **01,** 885.

Steam vessel. **1901.** $12,000 allotted for tug with barge to transfer material; work nearly completed; suspended owing to machinist strike. **01,** 92, 893.

1902. $8,255.39 allotted. Vessel completed; named *Gen. Alexander*. **02,** 779.

Tool rooms and rammer racks. **1901.** $700 allotted. Work completed. **01,** 885.

Part 48, FPTT. Preservation and Repair.

1897. Slopes of mortar battery No. 1 repaired; 4 platforms for 8-inch converted rifles nearly finished; minor work. **97,** 750.

1898. Four platforms for converted rifles completed and armed; $3,700 allotted; work begun on 10 others; 3 built on n. side of B. and 3 on an isld. in the B. On the isld. the old timber magazine was repaired. **98,** 786.

1899. $5,375 allotted. General care and preservation. **99,** 989.

1900. $6,480 allotted. General care and preservation. **00,** 1005, 1010, 1015.

1901. N. side—$2,734 allotted for replacing asphalt covering with a concrete roof, emplacements for three 12-inch guns, disappearing battery; work finished; itemized statement of work given. **01,** 869. Islds. in H.—watchman employed, general care of buildings, etc.; $1,022 allotted. **01,** 872. S. side—$8,244 allotted. Fence constr. around reservation to keep off trespassers; other misc. work done. **01,** 886.

1902. N. side—at battery for three 12-inch guns, concrete roof painted; some work done in magazine galleries; whitewashing rooms and passages. **02,** 765. Two 5-inch R. F. guns; water piping repaired; earth slope sown with alfalfa. **02,** 765. Two 8-inch guns—steel grate installed. **02,** 765. Misc. repairs; dry rubble wall erected. **02,** 765. S. side—repairs made at various batteries; itemized statement given. **02,** 775, 776.

Part 49, FPTT. Range and Position Finders.

1898. Shelter of Lewis range finder—gossamer cloth provided. **98,** 788.

1899. $18,000 allotted for building 13 range-finder shelters of type A and 11 of type B. On s. side of B.—1 shelter completed and work on 4 others; work suspended owing to changes of sites. Piers of emergency range finder, type B, near emplacements 10 and 16, completed. At another point, 1 pier built and work completed for another finder. On n. side of B.—excavation made for 2 piers and concrete work completed, awaiting the roofs. Work suspended owing to change of sites **99,** 989.

1900. N. and s. sides of B.—2 partly completed range-finder shelters that could be utilized for the new system were completed; 2 more stations completed; itemized cost of work. **00,** 1015, 1016.

1901. Constr. of a supplementary observing station; work completed. **01,** 885. $800 allotted. Constr. 2 observing stations at emplacements 18 and 19 of 12-inch barbette batteries; work completed. **01,** 885. N. side—2 remaining shelters built. S. side—fourth shelter built. The entire 8 shelters transferred to Artillery. **01**, 891. Datum beacons for range finders. $725 allotted for constr. 3 datum beacons; 2 set. **01**, 892.

1902. $450 allotted. 12-inch mortar battery; observation station built in this battery; itemized statement given. **02**, 774. $2,100 allotted for constr. battery-commander's station; site selected; plans and ests. in preparation. **02**, 778. Installing beacon on n. side of H. completed. **02**, 779. $39.18 allotted for material for base end houses. **02**, 779.

Part 50, FPTT. Sea Walls and Embankments—Fort Point.

Excavation of sea wall completed, constr. in progress; bulkhead for protection of roadway built; minor work. **68**, 20. Sea wall 600′ long completed; work begun on an apron of masses of r. in front of chan. sides of the fort. **69**, 20. Apron 709′ long in front of the sea wall on the chan. fronts completed; 3,500 t. of st. used. **70**, 27.

Part 51, FPTT. Sites.

Point Lobos—proceedings in progress for 54.05 acres. **92**, 10. S. side of B.—$40,000 allotted. Proceedings in progress. **00**, 1003. $3,969.20 allotted condemnation suit; proceedings concluded; land acquired; payments made. **01**, 896. Records—$2.70 allotted for correction of records. **02**, 778.

Part 52, FPTT. Submarine Mines.

1891. Two mining casemates completed, work begun on excavation for another one. **91**, 8.

1892. Mining casemate completed and storage shed erected. **92**, 8.

1893. $7,590 allotted. Work begun, excavation and concrete work completed, and casemate nearly finished. Itemized cost of work. **93**, 623.

1894. Mining casemate completed. **94**, 11.

1897. $8,000 allotted for a torpedo casemate. **97**, 745.

1898. Work begun on torpedo casemate in July 1897, and completed in November, 1897. Overhead traveler installed in the cable tank and 1 in the torpedo shed. **98**, 795. $47,000 allotted for torpedo defense; material purchased and first mine planted June 11, 1898; 42 mines were placed. **98**, 796.

1899. $150 allotted for purchasing electric-light materials; no funds used. $1,785 allotted for repairs of car tracks that were injured by storm; r. revet. built alongside to protect it from further damage. **99**, 991. $3,000 allotted for casemate No. 2; completed under contract. $2,000 allotted for an additional brick engine house at this casemate; work completed under contract. $3,350 allotted for an additional cable tank and torpedo station; work completed. Laying of mines continued till July 16, but laying of cables continued. and the entire first line of mines across the B, was completed on August 13. All mines and cables removed from water, cleaned, and stored; work completed in November; itemized cost of work. **99**, 991. 992.

1900. $600 allotted for pay of keeper and expenses of torpedo station; racks erected, completing the torpedo shed. Additional cable tank at the torpedo station completed. **00**, 1017, 1018.

1901. $1,200 allotted. Repairs to damaged torpedo shed, keeper's dwelling; searchlight outfits transferred; minor repairs, etc.. **01**, 894.

1902. $610 allotted. Obsolete material shipped to Willets Point; glass replaced in windows and screens put up; torpedo-shed roof repaired. **02**, 780.

Part 53, FPTT. Supplies for Seacoast Defenses.

1900. $1,000 allotted. No expend. **00**, 1017.

1901. Electric supplies purchased and alterations made to switchboards. **01**, 893.

Part 54, FPTT. Survey for Land Defenses.

1866–68. Survey in progress. **67**, 15; **68**, 20.

FPWW. COLUMBIA RIVER FORTIFICATIONS.

(NOTE.—Reports on these works from 1903 to 1912 are of a general character only. See the first 15 pages of each annual report from 1903 to 1912.)

Part.	Title.	Period.
1	Contracts	1897
2	Engineering features	....
3	Engineers—Chief of Engineers	1866–1902
4	BE	1882
5	In charge	1866–1901
6	Assistants	1870–1900
7	Forts, etc. (allotments, operations, etc.)	1869–1912
8	Fort Stevens, Oreg	1869–1886
9	Fort Canby, Wash	1875–1886
10	Cape Disappointment, Wash	1870–1872
11	10-inch gun battery, 6 emplacements	1897–1901
12	Two emplacements, 8-inch rifles	1897–1901
13	Emplacements, eight 12-inch mortars	1898–1901
14	Emplacement, one 8-inch rifle, experimental disappearing carriage, model 1894	1898–1901
15	Site 1—two emplacements, 15-pounder R. F. guns	1899–1901
16	Two emplacements, 6-inch R. F. guns	1899–1900
17	Two emplacements, 6-inch rifles, disappearing carriages, model 1898	1899–1901
18	Emplacement, 15-pounder R. F. gun	1900–1901
19	Emplacements, two 6-inch R. F. guns, pedestal mounts	1901–1902
20	Site 2—two emplacements, 15-pounder R. F. guns	1899–1900
21	Two emplacements, 6-inch rifles, disappearing carriages, model 1898	1899–1901
22	Emplacement, 15-pounder R. F. gun	1900–1901
23	Platform, 15-inch S. B. gun	1901
24	Miscellaneous (Water; Drainage; Electricity; Hoists, Telautographs)	1898–1902
25	Preservation and repair	1898–1902
26	Range and position finders	1899–1901
27	Sea walls and embankments	1877–1878
28	Mines	1897–1900
29	Supplies	1901

Part 1, FPWW. Contracts.

1897. Portland cement, 3,000 barrels, at $2.18 per barrel; broken st., 65¢ per c. y. Wharf, $9,302. **97,** 762.

Part 2, FPWW. Engineering Features.

Air spaces. **02,** 2494 (pl.).

Asphalting. Courses of asphalt. **02,** 2494 (pl.). Laying. **02,** 2484 (pl.). Courses turned up under coping. **02,** 2483, 2494 (pl.). Asphalting st. joints. **02,** 2494 (pl.). Waterproofing with asphalt. **02,** 2494 (pl.).

Booths for telautographs. **03,** 2424 (pl.). Provisions for booths in walls. **05,** 3032 (pl.).

Boards, wire, ceilings. **02,** 2494 (pl.).

Communications, system of. **99,** 1003; **03,** 2423.

Concrete work, ceilings. **02,** 2478. Closets in walls. **02,** 2477, 2480, 2494 (pl.). Cracks in, old RR. iron to prevent. **99,** 995, 1002. Filling with linseed oil. **99,** 1003. Repairing. **00,** 1023. Repairing surface cracks. **02,** 2487. Finishing, granolithic finish. **99,** 1001. Forms. **02,** 2486, 2494 (pl.). Good and bad work, examples. **02,** 2494 (pl.). Gun blocks. **02,** 2479. Leaks in, experiments to prevent. **01,** 924. Manufacturing. **02,** 2484; **99,** 1001. Mixer building. **02,** 2494 (pls.). Overhead cover. **02,** 2480. Parapets, finishing top surfaces. **00,** 1025. Loading platforms. **02,** 2478. Reinforcing. **02,** 2477, 2494 (pl.). Tamping. **03,** 2424.

Condensation, controlling. **00,** 1023; **01,** 924. "Recent works" give no trouble from. **01,** 924. Advantage of ventilators proved. **01,** 925. Various methods of assuring ventilation and noncondensation. **02,** 2488.

Construction, salient details of. **01,** 923. Plant layout. **02,** 2494 (pl.). Plant. **97,** 756; **99,** 1000; **02,** 2491. Material bunkers. **02,** 2494 (pl.).

Doors, steel doors. 02, 2494 (pl.).

Drainage, general arrangement for, battery constr. on beach sand. 02, 2494 (pl.). Water drain in ventilator. 02, 2494 (pl.).

Dryness, providing for. 01, 923.

Electricity, plant. 98, 798; 99, 997; 00, 1022.

Embankments, sand for, placing. 99, 1002.

Fireplaces, provisions for, in concrete. 02, 2480, 2494 (pl.).

Foundations, beds. 02, 2475, 2476.

Gudgeons, setting. 02, 2480.

Hydrants, walls, loading platforms. 05, 3033 (pl.).

Leaks, methods of preventing. 01, 924.

Lighting, conduits and wireboards. 02, 2482. Various arrangements. 02, 2495.

Lining, hollow tile for. 05, 3032 (pl.).

Lockers, arrangements for. 03, 2424 (pl.).

Materials, costs. 97, 758, 761; 99, 1000. Obtaining and delivering. 02, 2493. Handling to mixers. 02, 2494.

Paints, paints and washes. 02, 2494.

Railings and stanchions. 02, 2494 (pl.).

Recesses, providing, for wireboards. 02, 2494 (pl.). Speaking tubes. 02, 2494 (pl.). Hydrants. 02, 2494 (pl.). Blackboards. 05, 3032 (pl.).

Speaking tubes, arrangements or. 02, 2481; 03, 2423; 04, 3739 (pl.).

Stairways, details. 05, 3032 (pl.).

Stanchions. (See Railings.)

Switches, 3-way switches. 04, 3739. Switchboard arrangements. 02, 2494 (pl.).

Titles, battery titles formed in cement. 05, 3033.

Trackage. 02, 2492, 2494 (pl.).

Ventilation, system. 00, 1023.

Walls, reinforcing traverse walls. 05, 3032 (pl.). Reinforcing vertical walls. 05, 3033 (pl.).

Water, connections. 02, 2481.

Waterproofing, various methods. 02, 2482.

Wharf, RR. wharf and unloading arrangements. 02, 2494 (pl.).

Windows arrangements for, in concrete. 03, 2424 (pl.).

Part 3, FPWW. Engineers.

Chief of Engineers. R., 66, 18; 68, 20; 69, 19; 70, 28; 71, 25; 72, 24; 73, 25; 74, 29; 75, 28; 76, 29; 77, 24; 78, 27; 79, 32; 80, 54; 81, 55; 82, 54; 83, 50; 84, 55; 85, 48; 86, 47; 95, 5, 96, 20; 97, 21, 756; 98, 31, 797; 99, 36, 993; 00, 33, 1018; 01, 34; 02, 35; 03, 9; 04, 5, 9; 05, 5, 10; 06, 5; 07, 5; 08, 9; 09, 10; 10, 12; 11, 8; 12, 7.

Part 4, FPWW. Board of Engineers.

1882. Constituted to consider and report upon the constr. of fortifications, and what number, if any, could be dispensed with. 82, 428.

Part 5, FPWW. Engineers in Charge.

Col. R. E. De Russey, 1866.
Maj. G. H. Elliott, 1866–69.
Maj. G. H. Mendell, 1870–71.
Maj. H. M. Robert, 1871–74.
Maj. N. Michler, 1874–76.
Maj. J. M. Wilson, 1876–78.
Maj. G. L. Gillespie, 1880–82.
Capt. C. F. Powell, 1882–86.
Maj. J. C. Post, 1896.
Capt. H. Taylor, 1896.
Maj. W. L. Fisk, 1896–99.
Capt. W. C. Langfitt, 1900–02.
Capt. W. W. Harts, 1900–01.

Part 6, FPWW. Assistant Engineers.

Capt. C. W. Raymond, 1870.
Capt, H. Taylor, 1896.
Capt. A. F. Flagler, 1896–98.
Lt. W. D. Connor, 1898.
Lt. A. A. Fries, 1899–1900.

Part 7, FPWW—

FORTS AND BATTERIES.

Part 8, FPWW. Fort Stevens, Oreg. (South Side of River).

1869. Scarp revet. removed and exterior slope of parapet extended to bottom of ditch; covered way with parapet built along the counterscarp; minor repairs. **69,** 19.

1870. 300′ of facing of counterscarp relaid; slopes resodded. **70,** 28.

1871. Picket fence erected. **71,** 26.

1875. Postern of work repaired. **75,** 28.

1876. New platform built for 15-inch gun, revet. in front renewed; revet. also renewed in front of one 10-inch and three 8-inch guns and the earthwork adjacent graded and sodded. **76,** 29.

1877. Revet. of interior slopes renewed, old traverses renewed, and minor work; sea wall protection built. **77,** 24.

1878. Shore protection built; minor repairs to gun platform and brs. **78,** 28.

1879. Drain to moat put in order, revet. of sally port strengthened; the old lining of the passage leading to the magazine chamber strengthened, and a substantial interior waterproof lining added. **79,** 33.

1880. Earth covering removed from sally port; wooden drain to moat replaced by an 8-inch tile drain; minor work. **80,** 54.

1881. Sally port wholly rebuilt; revet. of traverses on both sides of 15-inch gun rebuilt and earth sodded; minor work. **81,** 55.

1883. Repair of drains and moat; powder house built, work on breast-high plank walls, and shore protection. **83,** 50.

1884. Marsh sod revet. of interior slope repaired; 4 shot platforms and 5 gun platforms built; work on magazine. **84,** 55.

1885. Repair of magazine completed. **85,** 48.

1886. Seven gun platforms rebuilt; minor work and repairs. **86,** 48.

Part 9, FPWW. Fort Canby, Wash. (North Side of Chinook River).

1875. Two new gun platforms built. **75,** 28.

1876. Magazines of w. battery built, 10-inch gun platforms in e. battery rebuilt, and new revet. placed in front. **76,** 29.

1878. Main magazine painted. **78,** 27.

1880. Revet. of interior slopes of center battery and part of revet. of right battery removed; platforms and revet. of 15-inch gun battery rebuilt new roof built on powder magazine; minor work. **80,** 54.

1881. Powder magazine painted. **81,** 55.

1882. Rampart of center battery extended on the left and a platform placed for a 12-inch rifle received; repairs of breast-high plank walls; minor repairs. **82,** 55.

1884. Service magazine and 3 gun platforms at center battery rebuilt; minor repairs made. **84,** 55.

1885. Repair of service magazine and 2 gun platforms at the left battery; minor repairs in center battery and to the power house. **85,** 48.

1886. Five gun platforms built at the right battery and shot beds at 3 batteries. **86,** 48.

Part 10, FPWW. Cape Disappointment, Wash.

1870. Powder house; concrete foundation built. **70,** 28.

1872. Painting powder house with fireproof paint. **72,** 24.

Part 11, FPWW. 10-inch Gun Battery, Six Emplacements.

1897. Work begun September, 1896, for 4 emplacements; steam shovel, capacity 1¼ c. y., bought; excavation and concrete work completed; 90,140 c. y. excavated and placed in parapet fill, completing it and parados; 3 guns and carriages received and mounted. Description of plant; itemized cost of constr. materials. **97,** 756.

1898. The other carriage and gun received and mounted; rear stairways built for the emplacements; handrails put around the loading platforms; parapets, parados, and rear fills completed and sodded; 107,530 c. y. sand placed; 13,208 c. y. concrete placed in the 4 emplacements; 1,105 c. y. of this large r. in pieces; drainage system completed. The 4 emplacements completed, except the steel cover for the observation station, with ammunition carriers, crane, etc., turned over to the commanding officer, Fort Canby, March 16. **98,** 797.

1899. $25,000 allotted. Work begun, 1898, for 2 additional emplacements; 9,994 c. y. concrete placed; 25 t, old rails embedded in the concrete; 2 courses laid every 12′ longitudinally and every 14′ transversely to tie together the concrete mass to prevent cracks; 41,267 c. y. sand excavated and placed for parapet fill; machinery installed; emplacements practically completed. **99,** 994.

1900. Connection made in rear of traverses between guns of emplacements 1 to 4 to allow ammunition to be taken from one platform to the next. Necessary changes made in platforms for floor plates of 18 inches instead of 12 inches. One 10-inch disappearing carriage and two 10-inch guns received; the base ring set in emplacement 5 and the carriage and gun mounted by the Artillery troops. The 2 A. R. F. emplacements, 5 and 6, turned over to the commanding officer June 28, 1900. **00,** 1019.

1901. Gun and carriage emplacement 6 mounted by Artillery; cables laid; parapet surfaces given 2 coats asphalt to stop leaks; plant dismantled; grounds cleared. **01,** 896.

Part 12, FPWW. Two Emplacements for 8-inch Rifles.

1897. Work begun in 1896. Wharf nearly a mile long; built under contract for $10,867.64; 10,905 c. y. excavated for foundations and necessary buildings; plant erected. Description of work o. building wharf; itemized cost of constr. materials. **97,** 759.

1898. Concrete work begun July 7. 4,500 c. y. placed and 15,860 c. y. earth excavated, including some excavation in front of the emplacements to secure the desired field of fire; 9,900 c. y. earth deposited as fill in the parapets; drainage system completed; 2 guns and carriages received and mounted, and apron placed after full settlement o. parapet fill. **98,** 800.

1899. Emplacements wired; lamps and switches put in. Several rooms and passages leak slightly because of cracks in parapet. **99,** 997.

1901. Storage battery installed. **01,** 897.

Part 13, FPWW. Emplacements for Eight 12-inch Mortars.

1898. Work begun in August. 6,173 c. y. concrete and 39,740 c. y. sand filling placed; drainage system completed; 7 carriages received and mounted; wiring for electric lights completed, and a storage battery of 52 cells, with switchboard, installed. Battery nearly completed. **98,** 798.

1899. The other mortar carriage received and mounted. Granolithic finish placed on the pits and the completed battery turned over to the Artillery on Jan. 17, 1899. Cracks appearing in the apron of each mortar pit, causing slight leaks in the shell rooms. **99,** 996.

1900. Eight mortars mounted by the Artillery in July. $2,000 allotted for a new drainage system; work completed. **00,** 1020.

1901. Pit aprons given thin coat of asphalt. **01,** 897.

Part 14, FPWW. Emplacement for One 8-inch Rifle, Experimental Disappearing Carriage, Model 1894.

1898. Work begun in August. 5,615 c. y. excavated and 2,805 c. y. concrete placed, of which amount 17% was large st. Drainage system completed. **98,** 800.

1899. Emplacement wired. Some trouble experienced from dampness and small leaks. **99,** 997.

1901. Carriage and gun mounted by Artillery June, 1901. **01,** 898.

Part 15, FPWW. Site 1—Two Emplacements for 15-pounder R. F. Guns.

1899. $12,000 allotted. Some constr. materials received. **99,** 997.

1900. Work completed, including the wiring for electric light. 756 c. y. concrete placed and 3,384 c. y. sand placed in parapet. Fence built around battery. No armament received. Emplacements were turned over to the commanding officer June 28, 1900. **00,** 1020.

1901. Base castings set; guns mounted. **01,** 897.

Part 16, FPWW. Site 1—Two Emplacements for 6-inch R. F. Guns.

[1]**1899.** Plans submitted; action deferred; kind of mount not definitely determined. **99,** 998.

1900. $15,000 allotted. No money to be expended till receipt of further instructions. Details of mount not perfected. **00,** 1024.

Part 17, FPWW. Site 1—Two Emplacements for 6-inch Rifles, Disappearing Carriages, Model 1898.

1899. $57,600 allotted. Constr. materials received. **99,** 998.

1900. Work begun; 4,342 c. y. concrete placed and 12,036 c. y. sand used for parapet fill; drainage system installed; fence built around battery; carriages received and base rings set; carriages mounted by the Artillery; changes made in the system of electric lighting; rearrangement of the storage battery. $1,500 allotted for a water-supply system; work begun; emplacements turned over to the commanding officer on June 28, 1900. **00,** 1020.

1901. Grounds cleared and graded; macadam road made; emplacements wired and storage battery installed; guns not yet received. **01,** 897.

Part 18, FPWW. Site 1—Emplacement for 15-pounder R. F. Gun.

1900. $5,450 allotted. Material advertised for. **00,** 1024.

1901. Work completed and turned over Nov. 12, 1900. **01,** 897.

Part 19, FPWW. Site 1—Emplacements for Two 6-inch R. F. Guns on Pedestal Mounts.

1901. $29,000 allotted. Drawings and est. submitted; excavation commenced; 15-inch S. B. gun moved from its platform to the banquette tread entirely clear of proposed emplacements. **01,** 897.

1902. Work completed: turned over Jan. 17, 1902; ammunition hoists and electric plant installed; guns and mounts not yet delivered. **02,** 782.

Part 20, FPWW. Site 2—Two Emplacements for 15-pounder R. F. Guns.

1899. Revised plans approved. $10,610 allotted. Sand for concrete received. **99,** 998.

1900. Work begun in August, 1899. 7,755 c. y. excavated and 723 c. y. concrete placed. A macadam roadway built to connect with the 6-inch emplacement. Battery to be lighted from the electric-light plant in the 6-inch battery. No armament received. Emplacements turned over to the commanding officer on June 28, 1900. **00,** 1023.

Part 21, FPWW. Site 2—Two Emplacements for 6-inch Rifles, Disappearing Carriages, Model 1898.

1899. Revised plans approved. $57,600 allotted. Work begun clearing site of the battery. **99,** 998.

1900. Work begun; excavation completed: 8,765 c. y. removed; 3,859 c. y. concrete placed; all drainage and water systems completed; all machinery installed; macadam roadway built connecting with the 15-pounder battery. Two carriages received and unloaded, then turned over to the Artillery for mounting; work completed. Battery is designed to accommodate duplicate oil engine and dynamo, electric light and power plant, doing away with all outside wiring and the storage battery; contract made for this plant. Emplacements turned over to the commanding officer on June 28, 1900. **00,** 1022.

1901. Electric-light plant installed. **01,** 898.

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[1] Refers to 6" B. L. R., **99,** 998.

Part 22, FPWW. Site 2—Emplacement for 15-pounder R. F. Gun.

1900. $4,840 allotted. Materials advertised for. **00,** 1024.

1901. 3,200 c. y. excavated; 296 c. y. concrete laid; emplacement completed Oct., and turned over to Artillery Oct. 28, 1900. **01,** 898.

Part 23, FPWW. Platform for 15-inch S. B. Gun.

1901. Dismounted and removed to permit constr. of two 6-inch emplacements; pedestal mounts. **01,** 897.

Part 24, FPWW. Miscellaneous.

Electric-light stations. **1898.** Site 1—683 c. y. concrete placed for foundations; wiring finished and station completed; description of plant. **98,** 798. Site 2—1,965 c. y. earth and 380 c. y. r. excavated for foundations; 400 c. y. concrete placed; building nearly completed. **98,** 801.

1899. Site 2—floors of the 2 rooms finished; work completed June 16, 1898, and turned over to the commanding officer. **99,** 997.

1900. Site 2—plant installed and in operation for direct lighting of the three 8-inch emplacements; storage battery received, ready for installation. **00,** 1022. Both plants completed and turned over to Artillery Oct. 29, 1900, and Jan. 19, 1901, respectively. **01,** 898.

1902. $1,400 allotted for electric-light station, site 1; old boiler condemned and replaced by a vertical boiler. **02,** 782.

Water supply. **1901.** The 10-inch, 12-inch, and 6-inch batteries provided with their own water-supply system. **01,** 897.

Drainage system. **1901.** Work of changing drainage system of 10-inch mortar batteries completed. **01,** 897.

Searchlights, chain hoists, telautographs. **1902.** Est. for proposed location and installation of two 36-inch and six 24-inch searchlights submitted; plans for providing older batteries with suitable chain hoists submitted; detailed drawings submitted of cost for installing telautographs for guns of 8-inch caliber. **02,** 783.

Part 25, FPWW. Preservation and Repair of Fortifications.

1898. Two 10-inch S. B. guns dismounted and a new platform for a 15-inch front-pintle platform built on their site. Carriage received and mounted and the 15-inch S. B. gun moved from the old center-pintle platform and mounted on new carriage. The old jetty, shore, and wharf trestle repaired; 10,767 c. y. sand filling placed in the trestles; foundation of the water-supply tank renewed, new windmill tower built, and a new well driven. **98,** 800. Wharf and plant repaired. **98,** 801. S. side of R.—$2,000 allotted; quarters and buildings repaired and a wooden platform for 15-inch Rodman S. B. gun built. N. side of R.—$150 allotted for repairs to powder magazine; a new tin roof placed. **98,** 803.

1899. $1,775 allotted. Old fort repaired; electric plants operated and cared for, storage batteries regularly charged, new quarters built for accommodation of 180 men, and general repair of constr. plant. **99,** 996, 999, 1,004.

1900. $2,550 allotted. Cracks in the pits, aprons of the mortar battery and 8-inch battery partly repaired; method of work. $1,410 allotted for care of electric-light plant and storage batteries. **00,** 1023.

1901. $480 allotted. Electric-light plants charged and cared for; stoppage of leaks; storing and caring for mining material; materials transferred to Artillery. **01,** 899.

1902. Leaks in passages stopped; repairs at 6-inch and 8-inch emplacements; leaks in apron stopped by asphalting. **02,** 782.

Part 26, FPWW. Range and Position Finders.

1899. An 8-inch cast-iron pipe set in the concrete for a type B range finder; platform with pipe railing built around it for convenience in working the instrument. **99,** 995.

1900. $2,729 allotted for a battery-commander's station, type A, for the 10-inch battery; station completed in May; given extra protection of concrete because of its exposed position. $1,666 allotted for a battery-commander's station, type A, for the 8-inch battery; work completed in May. **00,** 1021. $225 allotted for mounting bases for type B, range and position finders at 2 sites. One mounting was installed at the first site with a wooden stairway leading to it and another mounted at the second site. **00,** 1022.

1901. Site 1 — battery-commander's station turned over to Artillery Nov. 29, 1900. **01,** 897. Site 2—battery-commander's station turned over to Artillery Nov. 29, 1900. **01,** 898.

Part 27, FPWW. Sea Walls and Embankments.

Fort Stevens—1,000 l. f. st. and brush revet. built to protect sea wall. **77,** 24. New revet. of brush and st. and several small wing dams built along the shore of Point Adams. **78,** 28.

Part 28, FPWW. Submarine Mines.

1897. $7,500 allotted. Work begun in April on a mining casemate. RR. trestle 1,200′ long built for transporting materials to site of work; 1,267 c. y. excavated and 489 c. y. concrete placed, nearly completing the work. **97,** 759. $6,000 allotted for a second mining casemate; constr. materials received. **00,** 762.

1898. Site 1—mining casemate completed, including 750′ of gallery; 12,263 c. y. sand for protection and 718 c. y. concrete placed. **98,** 798. $2,000 allotted for a cable tank; work begun in April and completed in May. **98,** 799. Site 2—mining casemate: 4,177 c. y. excavated; 635 c. y. concrete placed; work nearly completed. **98,** 801. $8,000 allotted for torpedo defense; materials received and cables laid, but no mines planted. $1,000 allotted for gun platforms; no money expended. **98,** 802.

1899. Site 1—mining casemate: $734 allotted for concrete culvert in place of the 12-inch cast-iron pipe and for installing a blower; work completed. **99,** 996. Second cable tank built; house built over it; the track for the overhead traveler extended from the tank first built. **99,** 996. $5,800 allotted for a torpedo storehouse, which was completed. **99,** 996. Site 2—mining casemate: $1,885 allotted for altering casemate for the machinery required; work in progress. **99,** 997. All torpedo material cleaned and stored; 2 searchlight outfits received, 1 set up and operated. **99,** 999.

1900. Site 1—inside of casemate and engine rooms painted white and a blower provided. **00,** 1020. Torpedo storehouse: Steel roof trusses painted black and the ceilings and inside walls white; doors and windows were also painted. **00,** 1020. Site 2—mining casemate: Oil, engine, and dynamo room completed and a small blower provided. **00,** 1022. All torpedo material overhauled, cleaned, and stored. One drum of multiple cable found to have a defective core; new cable received. **00,** 1024.

Part 29, FPWW. Supplies for Seacoast Defenses.

1901. $800 allotted. Electric supplies furnished commanding officer. **01,** 899.

FPXX. PUGET SOUND, WASH., FORTIFICATIONS.

(NOTE.—Reports on these works from 1903 to 1912 are of a general character only. See the first 15 pages of each annual report from 1903 to 1912)

Part.	Title.	Period.
1	Contracts	1897–1901
2	Engineering features	
3	Engineers—Chief of Engineers	1896–1912
4	In charge, and assistants	1901–1902
5	Forts, etc. (allotments, operations, etc.)	1898–1902
6	Site 1—Battery, four 10-inch and two 12-inch guns, nondisappearing carriages	1898–1902
	Emplacements, two 5-inch R. F. guns, balanced pillar mounts	1899–1902
8	Emplacements, sixteen 12-inch mortars, mortar battery No. 3	1900–1902
9	Site 2—Emplacements, four 10-inch guns, disappearing carriages	1898–1902
10	Mortar battery, sixteen 12-inch mortars, No. 1	1898–1902
11	Emplacements, two 5-inch R. F. guns, balanced pillar mounts	1899–1902
12	Site 3—Battery, five 10-inch and two 12-inch guns, nondisappearing carriages	1898–1902
13	Emplacements, sixteen 12-inch mortars	1899–1902
14	Emplacements, two 5-inch R. F. guns, balanced pillar mounts	1899–1901
15	Site 4—Emplacements, three 8-inch guns, disappearing carriages	1899–1902
16	Emplacements, four 15-pounder R. F. guns, balanced pillar mounts	1900–1902
17	Emplacements, three 5-inch R. F. guns, Navy pattern, pedestal mounts	1900–1901
18	Emplacements, two 15-pounder R. F. guns, balanced pillar mounts	1900–1902
19	Site 5—Emplacements, two 6-inch R. F. guns, Brown's segmental pattern, Navy mounts	1899–1902
20	Emplacements, two 15-pounder R. F. guns, balanced pillar mounts	1900–1902
21	Emplacements, three 10-inch guns, disappearing carriages	1901–1902
22	Miscellaneous (Tug; Lighthouse; Mounting guns and carriages)	1898–1902
23	Preservation and repair	1900–1902
24	Range and position finders	1900–1902
25	Sites	1897–1900
26	Submarine mines	1899–1901
27	Supplies	1900

Part 1, FPXX. Contracts.

1897. Battery of four 10-inch guns and two 12-inch guns on nondisappearing carriages, $163,453.50. **97**, 768. Four emplacements for 10-inch guns on disappearing carriages, $84,980.50; battery for sixteen 12-inch mortars, $78,052.01. **98**, 809.

1898. Wharf, $7,080.20; steel-hull tugboat, $37,000; sand, large gravel and small gravel, 65¢ to $1 per c. y. **99**, 1011, 1015.

1899. Sand, small gravel, or broken st., 55¢ per c. y. **00**, 1029.

1901. Sand and gravel: constr. torpedo storehouse; clearing and excavating for three 8-inch gun batteries; for mortar battery No. 3; observation towers for fire and battery commander's stations, at sites 1 and 4. **01**, 909.

Part 2, FPXX. Engineering Features.

Concrete, cost per c. y. **00**, 1027, 1040, 1042.

Concrete, ingredients of. **00**, 1027.

Concrete mixing, method. **99**, 1009; **00**, 1043.

Plant, arrangement of (tracings). **99**, 1010.

Waterproofing, method of. **99**, 1006; **00**, 1026, 1027, 1028, 1037.

Work, cost of. **98**, 804, 805; **99**, 1005, 1007, 1008; **00**, 1038, 1040, 1041, 1042.

Part 3, FPXX. Engineers.

Chief of Engineers. **R.**, **96**, 21; **97**, 21, 763; **98**, 32, 803; **99**, 36, 1005; **00**, 33, 1026; **01**, 35; **02**, 36; **03**, 9; **04**, 5, 9; **05**, 5, 10; **06**, 5; **07**, 5; **08**, 9; **09**, 10; **10**, 12; **11**, 8; **12**, 7.

Part 4, FPXX. Engineers in Charge.

Capt. H. Taylor, 1896–01.
Lt. M. L. Walker, 1899.
Maj. John Millis, 1901–02.
Assistant. Lt. M. L. Walker, 1897-1901.

Part 5, FPXX—

FORTS AND BATTERIES.

Part 6, FPXX. Site 1—Battery for Four 10-inch and Two 12-inch Guns, Non-disappearing Carriages.

1898. $175,000 allotted. Work begun July 31, 1897, under contract. Wharf built. Two 10-inch emplacements completed, except installing machinery: 2 others have the concrete about half laid and two 12-inch emplacements have the excavation completed: floors laid and forms built for concrete. 94,781 c. y. excavated for foundations and 6,292 c. y. concrete placed. Four 10-inch platforms ready for carriages; the 12-inch platforms ready in about 3 weeks. Two 10-inch and two 12-inch carriages received. Itemized cost of work. **98,** 803, 811.

1899. $2,000 allotted. Work under contract completed Mar. 28, 1899. Part of the rooms covered with asphalt and a facing of hollow brick put on outside the concrete. These have proved perfectly dry, while the rooms where these precautions were not taken have proved damp. Itemized cost of work. Three 10-inch and two 12-inch carriages mounted and three 10-inch and two 12-inch guns received. **99,** 1005, 1014.

1900. Earth abutment against the walls through which moisture came excavated; the outside walls cleaned, plastered, and waterproofed with an alum-and-lye wash: a facing of hollow brick laid against the wall and the earth refilled. Three 10-inch and two 12-inch guns mounted and the 12-inch guns fired. The remaining 10-inch gun and carriage received; mounting in progress by the Artillery. All ordnance property turned over to ordnance officers. **00,** 1026, 1037, 1038.

1901. Traverses nearly completed; slope trimmed and seeded; fixtures placed; 10-inch gun mounted, and all 10-inch guns fired with service charges. **01,** 902.

1902. Additional work done on traverses, roads, and gutters; repairs to latrines; battery transferred to Artillery June 30, 1902. **02,** 785.

Part 7, FPXX. Site 1—Emplacements for Two 5-inch R. F. Guns on Balanced Pillar Mounts.

1899. $12,000 allotted. Plans prepared and part of plant accumulated. **99,** 1013.

1900. $3,000 allotted. Work begun July 25, 1899, by hired labor. Small wharf built. 1,116 c. y. concrete placed, completing the work; awaiting arrival of mount. Itemized cost of concrete; also total cost per c. y. Work suspended Mar. 31, 1900. **00,** 1031, 1037.

1902. Transferred to Artillery June 16, 1902. **02,** 785.

Part 8, FPXX. Site. 1—Emplacements for Sixteen 12-inch Mortars, Mortar Battery No. 3.

1900. Survey made of proposed site and plans and ests. prepared. **00,** 1038.

1901. $91,000 allotted. Site cleared, grubbed, and excavation done; constr. work in progress; drains placed; floors laid; mortar carriages received. **01,** 902.

1902. $1,025.10 allotted. Battery built; 8 mortar carriages mounted by Artillery; plans for electric service prepared. **02,** 785.

Part 9, FPXX. Site 2—Emplacements for Four 10-inch Guns, Disappearing Carriages.

1898. $95,000 allotted. Work begun Aug. 31, 1897, under contract. 37,154 c. y. excavated for foundations and 9,244 c. y. concrete placed; 2 emplacements practically finished, except lifts, trolleys, and other metal work. The platforms of the other 2 emplacements laid; floors laid and forms nearly all up. Itemized cost of work. **98,** 805.

1899. $7,600 allotted. Work under contract completed Dec. 15, 1898. Four carriages received. Itemized cost of work. **99,** 1006, 1014.

1900. Slopes and drains repaired; minor work to be done. Four carriages assembled and 3 rifles received and mounted. All ordnance turned over to the ordnance officer. **99,** 1026, 1039.

1901. Superior slope filled out; guns fired with service charges. **01,** 902.

1902. Railings placed about gun platforms; minor repairs made; plans and est. for electric service prepared; emplacements transferred to Artillery June 16, 1902. **02,** 784.

Part 10, FPXX. Site 2—Mortar Battery for Sixteen 12-inch Mortars, No. 1.

1898. $90,000 allotted. Work begun under contract. 6,291 c. y. excavated for foundations. Six carriages received. **98,** 808, 811.

1899. Work completed Mar. 14, 1899. Itemized cost of all work: 10 carriages received and 16 mounted. **99,** 1008, 1014.

1900. Slopes and drains repaired and battery whitewashed. Twelve mortars received and mounted. All ordnance property turned over to ordnance officer. **00,** 1039.

1901. $6,000 allotted. Slopes regraded and seeded: road completed: mortars fired with service charge. **01,** 902.

1902. Minor repairs; plans and est. for electric service prepared; battery transferred to Artillery June 16, 1902. **02,** 785.

Part 11, FPXX. Site 2—Emplacements for Two 5-inch R. F. Guns on Balanced Pillar Mounts.

1899. $12,000 allotted. Plans prepared. **99,** 1013.

1900. $6,850 allotted. Work begun Aug. 12, 1899, by day labor, and continued till Mar. 15, 1900, when work was suspended on account of lack of funds. Work to be resumed. **00,** 1031, 1039.

1902. Finishing work done; transferred to Artillery June 16, 1902. **02,** 785.

Part 12, FPXX. Site 3—Battery for Five 10-inch and Two 12-inch Guns, Non-disappearing Carriages.

1898. Plans being prepared. **98,** 810.

1899. $191,000 allotted. Work begun Sept. 6, 1898, by day labor. Excavation completed: 5,526 c. y. concrete placed. This included the manholes of drainage system, retaining walls, foundation throughout, all the storerooms at the ends of the emplacements, and practically the completion of all the gun platforms. **99,** 1010.

1900. $35,000 allotted. 18,456 c. y. excavated for foundations by day labor and 43,560 excavated by contract upon the superior slope put into back fill; 17,309 c. y. concrete placed and minor work. Battery completed, except whitewashing and finishing of the walls, painting, and minor work. Description of work, with itemized cost. Four 10-inch guns and one 12-inch carriage received and mounted and one 10-inch rifle received. **00,** 1027, 1040, 1042.

1901. Slope graded and seeded: mounting of all guns and carriages, except one 12-inch gun, completed; 3 special ammunition trucks constr. **01,** 901.

1902. One 12-inch gun and carriage mounted: plans and est. for electric service prepared: battery transferred to Artillery June 16, 1902. **02,** 784.

Part 13, FPXX. Site 3—Emplacements for Sixteen 12-inch Mortars.

1899. $160,000 allotted. Battery to be built by hired labor. **99**, 1012.

1900. Work begun July 6, 1899. 65,861 c. y. excavated for foundations and 10,290 c. y. concrete placed. Battery practically completed: erecting trolleys, whitewashing and painting, installing electric system, and minor work to be done. Summary of work, with itemized cost. Ten carriages received and mounted and 16 mortars and 2 carriages on hand. **00**, 1028, 1041, 1043.

1901. $6,300 allotted. Sixteen mortars and carriages mounted and partly cleaned and painted. **01**, 902.

1902. Repair work on slopes and roads; mortar and carriage dismounted; carriage sent away for repairs; plans for electric service; battery transferred to Artillery June 16, 1902. **02**, 785.

Part 14, FPXX. Site 3—Emplacements for Two 5-inch R. F. Guns on Balanced Pillar Mounts.

1899. $11 000 allotted. Plans prepared. **99**, 1013.

1900. Work begun April 7. Excavation completed and 1,095 c. y. concrete placed; mounts not yet received. Itemized cost of a c. y. of concrete. **00**, 1031 1043.

1901. Emplacements finished. **01**, 902.

Part 15, FPXX. Site 4—Emplacements for Three 8-inch Guns on Disappearing Carriages.

1899. Work in progress on a detailed survey of site. **99**, 1014.

1900. $103,000 allotted. Work begun Mar. 1, 1900. Wharf built, site cleared, and excavation made by contract; 12,637 c. y. removed for excavation and placed in back fill. Erecting constr. plant. **00**, 1030, 1044.

1901. $15,000 allotted. Battery constr.: nearly finished; guns received. **01**, 902.

1902. Work finished; plant removed; 2 carriages received. **02**, 785.

Part 16, FPXX. Site 4—Emplacements for Four 15-pounder R. F. Guns on Balanced Pillar Mounts.

1900. Plans and ests. prepared. **00**, 1032, 1044.

1901. $20,700 allotted. Excavation made; drainage system laid; plant prepared. **01**, 903.

1902. Battery practically finished, except electric-lighting plant and some painting. **02**, 785.

Part 17, FPXX. Site 4—Emplacements for Three 5-inch R. F. Guns, Navy Pattern, on Pedestal Mounts.

1900. $16,000 allotted for 2 emplacements. Some materials purchased. **00**, 1032, 1044.

1901. $3,200 allotted. Emplacements for 2 guns completed as far as possible. **01**, 903.

Part 18, FPXX. Site 4—Emplacements for Two 15-pounder R. F. Guns on Balanced Pillar Mounts.

1900. $8,500 allotted. Some materials purchased. **00**, 1032, 1044.

1901. $1,700 allotted. Battery partly constr.: over half of concrete in place. **01**, 903.

1902. Battery practically finished, except electric-lighting plant. **02**, 785.

Part 19, FPXX. Site 5—Emplacements for Two 6-inch R. F. Guns, Brown's Segmental Pattern, on Navy Mounts.

1899. $5,000 allotted. Detailed survey of site made. Condemnation proceedings instituted for possession of title. **99,** 1013.

1900. $15,000 allotted. Plans prepared; require modification to adapt them to the new style of mount; no information is at hand in regard to the requirements of the mounts; no work has been done. **00,** 1030, 1044.

1901. $30,000 allotted. **02,** 902.

1902. $30,000 allotted. **02,** 786.

Part 20, FPXX. Site 5—Emplacements for Two 15-pounder R. F. Guns on Balanced Pillar Mounts.

1900. $8,500 allotted. Some materials purchased. **00,** 1032, 1044.

1901. Excavation completed; drainage system laid; plant prepared. **01,** 903.

1902. $720 allotted. Rough concrete placed and doors hung. **02,** 786.

Part 21, FPXX. Emplacements for Three 10-inch Guns on Disappearing Carriages.

1901. $102,700 allotted. Excavation for foundation completed; drains laid; concrete plant prepared. **01,** 902.

1902. $40,000 allotted. Rough concrete completed; constr. work actively in progress; two 10-inch guns, 2 disappearing carriages received. **02,** 784.

Part 22, FPXX. Miscellaneous.

Construction of a steel tug. **1899.** $16,000 allotted. Work begun under contract. **99,** 1015.

1900. Work completed. Used for hauling scows and making surveys and inspections. Of great service in facilitating and cheapening the constr. work carried on since she was built. **00,** 1036.

New lighthouse station at Admiralty Head.

1900. $8,000 allotted. Plans prepared for a new station by the Lighthouse Department: turned over to the Engineer Department. **00,** 1035.

1902. Work in progress on constr. **02,** 790.

Mounting guns and carriages.

1898. $7,000 allotted. Two 10-inch and two 12-inch nondisappearing carriages and 6 mortar carriages received. Materials for mounting purchased. **98,** 811.

1899. $15,000 allotted. Three 10-inch and two 12-inch nondisappearing carriages and 16 mortar carriages mounted. Four 10-inch disappearing carriages, three 10-inch and two 12-inch guns received. **99,** 1014.

1900. $5,000 allotted. Six 10-inch guns, thirty-two 12-inch mortars, one 12-inch and five 10-inch nondisappearing gun carriages, and twelve 12-inch mortar carriages received. Two 12-inch and three 10-inch guns mounted on nondisappearing carriages, three 10-inch guns on disappearing carriages, and 12 mortars on their carriages. One 12-inch and four 10-inch nondisappearing carriages, four 10-inch disappearing carriages, and four 12-inch mortar carriages mounted. One 10-inch nondisappearing gun carriage and eight 12-inch mortar carriages partly mounted. Six 12-inch mortars moved to the emplacements ready for mounting. Two 12-inch and three 10-inch guns mounted on nondisappearing carriages, three 10-inch guns mounted on nondisappearing carriages, three 10-inch guns mounted on disappearing carriages, twelve 12-inch mortars mounted, two 10-inch guns not mounted, four 12-inch mortars not mounted, one 10-inch disappearing gun carriage mounted, one 10-inch nondisappearing carriage partly mounted, and 4 mortar carriages mounted, were turned over to the Artillery garrisons during the year. Since the above ordnance was turned over, the Artillery mounted one 10-inch gun on disappearing carriage and 4 mortars. **00,** 1033.

1901. $2,725 allotted. One 10-inch, twelve 12-inch mortars, two 5-inch, five 10-inch, one 12-inch, sixteen 12-inch B. L. mortars mounted. **01,** 908.

1902. $1,000 allotted. One 12-inch gun and carriage mounted: guns, mortars, and carriages painted. **02,** 790.

Part 23, FPXX. Preservation and Repair.

1900. $5,800 allotted. Slopes repaired; whitewashing and painting finished; waterproofing roofs of magazines: care of torpedo material and misc. work. **00,** 1034. $5,000 allotted for road betterment, retrimming and regrading slopes, and planting a windbreak at 10-inch and 12-inch gun battery at site 1. $3,700 allotted for repair of slopes of mortar battery No. 1. $2,934 allotted for clearing, grubbing, grading, and seeding certain areas at site 1. No work done under the above allotment. **00,** 1035.

1901. $3,200 allotted for latrines and water-supply system, site 4; $6,350 allotted for grading and road constr., site 1. **01,** 906.

1902. $900 allotted for road betterment, site 4. **02,** 789. $1,020 allotted for care and putting torpedo material in condition for permanent storage. **02,** 790. $575.10 allotted for care of batteries. **02,** 790.

Part 24, FPXX. Range and Position Finders.

1900. $4,926 allotted for a fire-commander's station at site 1; $2,370 allotted for 1 at site 2, and $5,000 allotted for 1 at site 3. Plans being prepared. **00,** 1035, 1038, 1039.

1901. $6,000 allotted for battery-commander's station, sites 2 and 3; $10,200 allotted for battery commander's station, site 4. **01,** 905, 906.

1902. Stations built. **02,** 787.

Part 25, FPXX. Sites.

1897. $650.74 allotted for surveys and incidental expenses; $3,480 for purchase of site 1; $7,200 for site 2; and $43,075 for site 3. Two sites were obtained partly by purchase and partly by condemnation; negotiations in progress for purchase of as much as possible of a third one. **97,** 763.

1898. Site 3 acquired partly by purchase and partly by condemnation proceedings. Proceedings begun for acquiring 2 more sites. **98,** 810.

1899. $475 allotted for purchase of site 4. Condemnation proceedings in progress. One additional tract of land purchased. Title of lands abutting on the reservations at the sites of 2 groups of batteries already built deeded to the U. S. by the State of Washington. Arrangements made whereby the lighthouse reservation at the same locality is to be transferred to the War Department in exchange for 2 pieces of land now part of the military reservation. **99,** 1014.

1900. $38,600 allotted. Proceedings for acquiring title to sites 4 and 5 completed and amount of award paid. **00,** 1037.

Part 26, FPXX. Submarine Mines.

1899. $1,008.85 allotted for a cable tank and torpedo storehouse. Title to proposed site not yet secured. Temporary storage tank for cable on hand prepared by throwing a crib and earthen dam across a small creek. **99,** 1016.

1900. $9,000 allotted for torpedo storehouse. Work begun April 25, under contract, the U. S. furnishing sand, gravel, and cement. Building partly completed. **00,** 1033, 1044.

1901. Building for storehouse for torpedo material practically completed: material moved into it. **01,** 903.

Port Angeles, Wash. $75,000 allotted for a reconnaissance to obtain data for developing a plan for defense. **98,** 811.

Part 27, FPXX. Supplies for Coast Defense.

1900. $500 allotted for purchase of approved supplies for the Artillery garrisons. No requisitions received. **00,** 1036.

FOPR.[1] PORTO RICO FORTIFICATIONS.

(NOTE.—Reports on these works from 1903 to 1912 are of a general character only. See the first 15 pages of each annual report from 1903 to 1912.)

Part.	Title.	Period.
1	Engineers (Chief of Engineers; in charge)	1901-1912
2	Preservation and repair	1901-1902
3	Range and position finders	1901-1902

[1] PR = Porto Rico office.

Part 1, FOPR. Engineers.

Chief of Engineers. R., **01**, 36; **02**, 37; **03**, 8, 9, 14, 17; **04**, 10, 12; **05**, 12; **07**, 12, 15.

Engineers in charge:
Capt. W. V. Judson, 1901.
Capt. C. A. F. Flagler, 1902.
Capt. F. R. Shunk, 1902.

Part 2, FOPR. Preservation and Repair.

1901. $16,000 allotted. Slight repairs to masonry work, El Morro. **01**, 909. $3,500 allotted for civilian assistants to engineer officers; $500 allotted or equipment of engineer troops. **01**, 910. Road constr. and misc. work. **01**, 910.

1902. $500 allotted. El Morro and outworks. Sentry box repaired; storeroom refloored; other misc. work done. **02**, 791. San Cristobal and outworks. Floors repaired; wire fence built; wooden br. rebuilt, etc. **02**, 791.

Part 3, FOPR. Range and Position Finders.

1901. $1,000 allotted. Plans prepared for conversion of an existing semaphore station on El Morro into a practice station for a type A finder. No work done. **01**, 909.

1902. Work on above completed in February, 1902. **02**, 791.

FOPC.[1] THE PANAMA CANAL.

See Part V of this index.

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[1] PC=Panama.

FOHI.[1] HAWAIIAN ISLAND FORTIFICATIONS.

Chief of Engineers. **R.**, **00**, 6, 7; **01**, 6; **02**, 7; **03**, 8, 9, 14, 17; **04**, 10, 11, 12; **05**, 12, 15; **06**, 10, 13, 14; **07**, 11, 12, 14, 15; **08**, 16, 17, 19, 20; **09**, 17, 18, 19; **10**, 19, 20, 23; **11**, 19; **12**, 17.

See also pp. 1809–1815.

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[1] HI—Hawaiian Islands office

FOPI.[1] PHILIPPINE ISLANDS FORTIFICATIONS.

Chief of Engineers. **R.**, **02**, 7; **03**, 8, 9; **04**, 10, 12; **05**, 12, 14, 15; **06**, 10, 11, 13, 14; **07**, 11, 12, 14, 15; **08**, 16, 17, 19, 20; **09**, 17, 18, 19; **10**, 19, 20, 23; **11**, 19; **12**, 17.

See also pp. 1809–1815.

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[1] PI=Philippine Islands office.

PART III.

MISCELLANEOUS REPORTS.

GUIDE TO THE USE OF PART III.

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1. ALPHABETICAL FINDING LIST AT THE BACK OF THIS INDEX.

(See also Abbreviations, page VII, Vol. II.)

There is a finding list at the back of this index, composed of the names of rivers, harbors, or works referred to in the abstracts throughout this index. The names are arranged alphabetically, with proper references following them to pages of this index.

The first page of the finding list presents information useful to the user of this index.

2. EXPLANATION OF SUBHEADS USED IN PART III.

The same general plan is followed as is outlined on page 21 of this index.

3. CONTENTS OF THE "MISCELLANEOUS" INDEX.

This Part III is intended as an index to—(*a*) matter which, in the reports of the Chief of Engineers, has been entitled "Miscellaneous;" that is, concerning public works not provided for in acts making appropriations for the construction, repair, and preservation of works on rivers and harbors, and fortifications; (*b*) matter which, in the reports of the Chief of Engineers, relates in a general way to river and harbor improvement, fortifications, or other works.

A complete list of the abstracts arranged under the term "Miscellaneous" is printed on page 2039 of this index.

The list referred to forms a general outline of the duties devolving upon the Corps of Engineers.

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MISC. 1. APPROPRIATIONS, ESTIMATES,[1] AND EXPENDITURES.

Each annual report of the Chief of Engineers refers to the appropriations made by Congress for the works referred to in the reports.

See each abstract in this index.

See summaries on pages 2279 of this index.

The "Laws affecting the Corps of Engineers" printed in each annual report also name the appropriations made for each work or locality named in those laws. See "Laws affecting the Corps of Engineers," on page 2329 of this index for the page references.

Additional details concerning appropriations are contained in H. D. 421, 57th Congress, 2d session, and also in Treasury Document 373, 1882 (now out of print). These two latter documents have been used to make a complete statement of the money devoted to any work named in the reports of the Chief of Engineers, particularly for the period preceding 1866.

Estimates are submitted in several ways. For example, each report of a survey usually contains an estimate of the cost of a proposed work. Each annual report also contains estimates of funds required for the work of subsequent periods, in the case of almost every work named in the report, if there is need of further appropriations.

The reports are, in the main, accounts relating to the expenditures of whatever funds have been appropriated.

Estimates of appropriations required (1901–1912).

Fortifications. **01**, 37; **02**, 38; **03**, 17; **04**, 12; **05**, 15; **06**, 13; **07**, 15; **08**, 20; **09**, 23; **10**, 24; **11**, 19, 24; **12**, 17, 22.

U. S. Engineer depots. **01**, 42; **02**, 45; **03**, 23; **04**, 17; **05**, 18; **06**, 16; **07**, 17; **08**, 23; **09**, 25; **10**, 27; **11**, 27; **12**, 25.

U. S. Engineer School. **01**, 42.

Engineer equipment of troops. **11**, 29; **12**, 26.

Rivers and Harbors. **01**, 118; **02**, 61; **03**, 36; **04**, 18; **05**, 20; **06**, 17; **07** 20; **08**, 25; **09**, 29; **10**, 32; **11**, 33; **12**, 31.

Philippine Islands.—Contingencies, Engineer Department, Philippine Islands.

In the prosecution of work of great importance in the Philippine Islands in remote and almost inaccessible localities the operations of the Engineer Department require funds of wide applicability and limited restrictions as to expenditure. Owing to the circumstances under which the work must be performed an appropriation of this character has been found essential to its satisfactory prosecution. Appropriations of $5,000 each for this purpose have been made for the fiscal years 1911, 1912, and 1913. **09**, 27; **10**, 31; **11**, 30; **12**, 27.

MISC. 2. BOARDS—THE BOARD OF ENGINEERS.

This is a board composed mainly of Engineer officers, acting in an advisory capacity to the Chief of Engineers in important questions of military engineering, fortifications, and river and harbor works related thereto.

Additions to the membership of the board have been made at times from various departments of the Army for the consideration of questions relating to the defenses of the coasts of the United States.

See list of members, "Fortifications" index, page 1799 of this book.

For references to reports, see page 1799 of this index.

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[1] Special estimates for maintenance of R. and H. work, etc., for 1909, H. D. 1462, 60th, 2d.

MISC. 3. CHIEF OF ENGINEERS—CHIEFS OF THE CORPS OF ENGINEERS.[1]

Name.	Rank.	Title.	Date of appointment.
Richard Gridley	Colonel	Chief Engineer	June —, 1775
Rufus Putnam	do	do	Aug. 5, 1776
Lewis du Portail	do	do	July 22, 1777
	Brigadier general	do	Nov. 17, 1777
	Major general	do	Nov. 16, 1781
Stephen Rochefontaine	Lieutenant colonel	Commander, Corps of Artillerists and Engineers.	Feb. 26, 1795
Henry Burbeck	do	Commander, First Regiment Corps Artillerists and Engineers.	May 7, 1798
Jonathan Williams	do	Principal Engineer	July 8, 1802
	do	Chief Engineer	Apr. 19, 1805
	Colonel	do	Feb. 23, 1808
Joseph G. Swift	do	do	July 31, 1812
Walker K. Armistead	do	do	Nov. 12, 1818
Alexander Macomb	do	do	June 1, 1821
Charles Gratiot	do	do	May 28, 1828
Joseph G. Totten	do	do	Dec. 7, 1838
J. J. Abert	do	Chief, Topographical Engineer	July 7, 1838
Stephen H. Long	do	do	Sept. 9, 1861
Joseph G. Totten	Brigadier general	Chief Engineer	Mar. 3, 1863
Richard Delafield	do	do	Apr. 22, 1864
	do	Chief of Engineers	July 13, 1866
Andrew A. Humphreys	do	do	Aug. 8, 1866
Horatio G. Wright	do	do	June 30, 1879
John Newton	do	do	Mar. 6, 1884
James C. Duane	do	do	Oct. 11, 1886
Thomas L. Casey	do	do	July 6, 1888
William P. Craighill	do	do	May 10, 1895
John M. Wilson	do	do	Feb. 1, 1897
Henry M. Robert	do	do	Apr. 30, 1901
John W. Barlow	do	do	May 2, 1901
George L. Gillespie	do	do	May 3, 1901
Alexander Mackenzie	do	do	Jan. 23, 1904
W. L. Marshall	do	do	July 2, 1908
W. H. Bixby	do	do	June 12, 1910

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[1] See Table of reports on page viii, Vol. II, of this index.

MISC. 4. CHIEF OF ENGINEERS—OFFICERS ON DUTY IN THE OFFICE OF THE CHIEF OF ENGINEERS.[1]

Maj. Q. A. Gillmore, 1866.
Lt. Col. H. G. Wright, 1866–67.
Lt. Col. J. D. Kurtz, 1866–70.
Lt. Col. I. C. Woodruff, 1866–70.
Maj. W. P. Craighill, 1866–70.
Capt. W. E. Merrill, 1866–67.
Col. J. G. Parke, 1868–87.
Lt. Col. T. L. Casey, 1868–78.
Maj. J. B. Wheeler, 1870–72.
Lt. Col. J. G. Foster, 1866–67 and 1872–74.
Maj. G. H. Elliot, 1874–82.
Maj. W. J. Twining, 1877–78.
Maj. H. M. Adams, 1879–95.
Lt. Col. J. M. Wilson, 1882–86.
Maj. C. W. Raymond, 1886–88.
Maj. J. C. Post, 1887–89.
Maj. T. Turtle, 1887–94.
Capt. C. B. Sears, 1888–90.
Maj. J. G. D. Knight, 1890–95.
Col. A. Mackenzie, 1895–03.
Capt. G. W. Goethals, 1894–98.
Capt. W. M. Black, 1895–97.
Capt. J. E. Kuhn, 1896–1900.
Lt. C. Harding, 1896.
Lt. J. S. Sewell, 1898.
Lt. E. Jadwin, 1897–98.
Maj. J. L. Lusk, 1898–03.
Capt. E. Burr, 1898–99.
Capt. W. L. Fisk, 1899.
Capt. J. C. Sanford, 1900.
Lt. C. S. Bromwell, 1900–02.
Lt. S. Cosby, 1900.
Maj. F. V. Abbot, 1900–10.
Lt. Col. W. R. Livermore, 1902.
Capt. M. M. Patrick, 1901–03.
Maj. H. F. Hodges, 1902–07
Capt. W. V. Judson, 1903–04.
Capt. C. W. Kutz, 1903–06.
Capt. W. J. Barden, 1906–09.
Col. S. S. Leach, 1908–09.
Maj. J. B. Cavanaugh, 1907–11.
Lt. R. R. Ralston, 1908.
Maj. W. B. Ladue, 1909.
Capt. E. N. Johnston, 1908.
1st Lt. R. C. Moore, 1908–10.
Lt. Col. E. Burr, 1910.
1st Lt. C. K. Rockwell, 1910.
Lt. Col. H. Taylor, 1911.
Maj. E. Jadwin, 1911.

MISC. 5. ENGINEERS, CORPS OF. (1900–1912.)

(For information on the same subject for preceding years, see each annual report at the beginning.)

1900–01. Holding commissions, 131. Five officers separated from corps: Brig. Gen. John M. Wilson, retired; Brig. Gen. Henry M. Robert, retired; Brig. Gen. John W. Barlow, retired; 1st Lt. Louis C. Wolf, retired; 2d Lt. W. H. Lee, killed. Added, by promotion of graduates from U. S. Military Academy, 10 second lieutenants. By act Feb. 2, 1901, corps consists of 160 officers and 3 battalions of 4 companies each of enlisted men. Actual strength: Peace footing, 100 men to company; war footing, 164 men. 32 officers and 8 companies of battalion on duty in Philippines, China, Porto Rico, and Alaska. Recommended that increase be made in number of field officers to reestablish ratio prevailing before passage of act Feb. 2, 1901. Table of distribution of officers. **01**, 3, 4.

1901–02. Holding commissions, 150. Separated from corps, 1: Capt. Jas. J. Meyler, died. Added to corps, by transfer from the line, 4 first lieutenants, 9 second lieutenants; by promotion of U. S. Military Academy graduates, 7 second lieutenants, 5 promotions to first lieutenants. Table of distribution. **02**, 3.

1902–03. Holding commissions, 153. Lost 7 officers: 2d Lt. Francis F. Longley, resigned; Capt. R. N. McGregor, died; Lt. Col. Andrew N. Damrell, retired; Col. S. M. Mansfield, Col. Jared A. Smith, and Col. Peter C. Haines, appointed brigadier generals; and 1st Lt. Edmund M. Rhett, resigned. Added, by promotion from U. S. Military Academy graduates, 10 second lieutenants. Table of distribution. At present it is necessary to so combine works and districts as to throw upon many officers such a number and variety of duties as to make it difficult at times for them to devote to the separate districts and the various items of work the proper detailed consideration. **03**, 3.

1903–04. Holding commissions, 159. Lost 4 officers: Brig. Gen. G. L. Gillespie, commissioned a major general, U. S. Army; Lt. Col. Chas. J. Allen, commissioned a brigadier general, U. S. Army, Col. Chas. W. Raymond, retired; 1st Lt. Nathaniel E. Bower, killed. Added, by promotion of graduates from U. S. Military Academy, 10 second lieutenants. Table of distribution. **04**, 3.

1904–05. Holding commissions, 165. Lost 4 officers: Maj. Theo. A. Bingham, commissioned a brigadier general, U. S. Army; Col. Alex. M. Miller, died; Col. D. P. Heap, retired; Col. W. A. Jones, retired. Added, by promotion from U. S. Military Academy, 13 second lieutenants. Table of distribution. **05**, 3.

1905–06. Holding commissions, 170. Lost 7 officers: Col. Thos. H. Handbury, retired; Maj. Eugene W. Van C. Lucas, resigned; Maj. Cassius E. Gillette, resigned; Lt. Col. C. F. Powell, commissioned a brigadier general, U. S. Army; Col. Chas. R. Suter, retired; 1st Lt. Ferd. Williams, died; Col. O. H. Ernst, retired. Added, by promotion from U. S. Military Academy, 9 second lieutenants. Table of distribution. **06**, 3.

1906–07. Holding commissions, 171. Lost 7 officers: Col. Wm. S. Stanton, retired; Capt. R. P. Johnston, resigned; Lt. Col. Jas. L. Lusk, died; Col. Wm. R. Livermore, retired; Col. W. H. Heuer, retired; Lt. Col. Geo. McC. Derby, retired; Col. Jas. B. Quinn, retired. Added, by promotion of graduates from U. S. Military Academy, 8 second lieutenants. Selection of Lt. Col. Geo. W. Goethals, Maj. David DuB. Gaillard, and Maj. W. L. Sibert as Isthmian Canal Commissioners. Also Maj. Edgar Jadwin in charge of a division of canal. Table of distribution. **07**, 3.

1907–08. Holding commissions, 172. Lost [illegible] officers: Col. Amos Stickney, retired; Col. Garrett J. Lydecker, retired; Maj. John S. Sewell, resigned; Col. Chas. E. L. B. Davis, commissioned a brigadier general; Col. Jos. H. Willard, retired; Col. H. M. Adams, retired; Brig. Gen. A. Mackenzie, retired; Col. Clinton B. Sears, retired. Added, by promotion of U. S. Military Academy graduates, 9 second lieutenants. Table of distribution. Increasing amount of work necessitates more officers to fill duties; 60 are recommended. **08**, 3.

1908–09. Holding commissions, 183. Lost 4 officers: Col. T. W. Symons, retired; Col. R. L. Hoxie, retired; Col. M. B. Adams and Col. E. H. Ruffner, retired. Added, by promotion from U. S. Military Academy, 15 second lieutenants. Table of distribution. **09**, 3.

1909–10. Holding commissions, 186. Lost 8 officers: Lt. Col. H. M. Chittenden, commissioned a brigadier general; 2d Lt. John A. Holabird, resigned; Col. John G. D. Knight, commissioned a brigadier general; Col. Smith S. Leach, died; Col. D. W. Lockwood, retired; Brig. Gen. W. L. Marshall, retired; Capt. John H. Poole, resigned; 1st Lt. Carlos J. Stolbrand, dismissed. Added, by promotion from U. S. Military Academy, 11 second lieutenants. Table of distribution. **10**, 3.

1910–11. Holding commissions, 190. Lost 1 officer: 1st Lt. Frederic E. Humphreys. Added, by promotion from U. S. Military Academy, 5 second lieutenants. Table of distribution. Act of Feb. 27, 1911, an increase of 5 colonels, 6 lieutenant colonels, 19 majors, 17 captains, and 13 first lieutenants. **11**, 3.

1911–12. Holding commissions, 194. Lost 3 officers: Col. Walter L. Fisk, retired; Col. Thos. L. Casey, retired; Maj. Edw. R. Stuart, appointed professor of drawing, U. S. Military Academy. Added, 1 probational second lieutenant, from civil life, and 6 second lieutenants from U. S. Military Academy by promotion. Table of distribution. **12**, 3.

MISC. 6. DEPOTS—ENGINEER DEPOT, FORT LEAVENWORTH, KANS.

In charge: Maj. S. S. Leach, 03, 04. Capt. H. Deakyne, 04, 05. Maj. T. H. Rees, 05, 06; 07, 08. Maj. C. A. F. Flagler, 09, 10. Maj. M. L. Walker, 11, 26.

1902–03. Additional pontoon material purchased, and repairs to that on hand. Purchase of various supplies and equipment for the Engineer shop of instruction. 03, 21, 703; 04, 15, 773; 05, 17, 775; 06, 14, 845; 07, 16, 873; 08, 21, 917; 09, 24, 961; 10, 26, 1075; 11, 26, 1137; 12, 24.

MISC. 7. DEPOTS—ENGINEER DEPOT, FORT MASON.

1905–06. At this depot the reserve and advance guard pontoon trains kept in repair and the tool equipment of, kept up to date. 06, 15, 847; 07, 17, 875; 08, 22.

MISC. 8. DEPOTS—ENGINEER DEPOT, FORT TOTTEN, WILLETS POINT (1900–1902).

(For similar information for preceding years, see Misc. 32, p. 2053 of this index.)

1900–01. Materials for repairs and instruction issued. Additions made to pontoon and bridge equipage, repairs to old pontoon wagons. Engineering Field Manual in preparation. Tools, etc., purchased and issued for troops on insular work. Material for road constr. purchased. Over 1,000,000 pounds submarine mining material issued. Torpedo manuals called in with view to their transfer to Artillery Corps. 01, 41, 947.

1901–02. Transferred to Washington Barracks, D. C. 02, 41.

MISC. 9. DEPOTS—ENGINEER DEPOT, HONOLULU.

This depot assembles and issues property and materials for the military survey of the island of Oahu, cares for property in store, makes such minor repairs to instruments as can be made locally, and obtains and issues such engineer supplies as are required by the Engineer troops stationed at Honolulu. 11, 26; 12, 24.

MISC. 10. DEPOTS—ENGINEER DEPOT, MANILA, P. I.

1909. This depot is the repository of two divisions of the advance guard ponton equipage, and for miscellaneous tools, property, and supplies required for issue and for reserve equipment in the Philippine Division. The depot also makes all ordinary repairs to instruments used in the military surveys in the Philippine Division. 10, 26, 1079 11, 26, 1141; 12, 24.

MISC. 11. DEPOTS — ENGINEER DEPOT, NEW YORK CITY.

In charge: Lt. Edw. H. Schulz.

1902–03. Depot at Willets Point, N. Y., closed June 30, 1902, and transferred to Army Building, New York City. All property disposed of by transfer and condemnation. Purchases of Engineering supplies; instruments purchased and repaired. 03, 21, 705.

1903–04. All property and records transferred to the Engineer Depot, Washington Barracks, D. C., and this depot discontinued on June 30. 04, 15, 775.

MISC. 12. DEPOTS — ENGINEER DEPOT, VANCOUVER BARRACKS.

1908–10. A ponton train consisting of the principal items of one division advance, and one division reserve, equipage transferred from Engineer depot at Fort Mason, Cal., to this depot. Overhauling done. **09**, 24; **10**, 26, 1077.

1910–11. Two Artillery gun sheds turned over to the depot for storage of equipment. Materials, tools, and supplies purchased and issued. **11**, 26; **12**, 24.

MISC. 13. DEPOTS — ENGINEER DEPOT, WASHINGTON BARRACKS.

1901–02. General property transferred from Willets Point to Washington Barracks. Purchase and issuance of material as required. **02**, 41, 807.

1902–03. No suitable building for an Engineer storehouse available. Many minor repairs and alterations made to old buildings. **03**, 19, 694.

1903–04. Routine work of repairs, etc. Minor repairs made to a number of Engineering models, and some sent to Louisiana Purchase Exposition at St. Louis, Mo. Details of work at depot given. **04**, 13, 760.

1904–05. Purchase and issue to the companies, troops, batteries, and posts of reconnaissance instruments prescribed in G. O No. 24, W. D., Feb. 14, 1905. **05**, 15, 757.

1905–06. New storehouse practically completed; used for storage of depot property **06**, 14, 837.

1906–09. New depot storehouse completed; new building for shops should be provided. Est. $12,500 for constr. of shed for protection of ponton wagons. **07**, 16, 867; **08**, 21, 909; **09**, 23, 957.

1909–10. Provision made for constr. shed. An additional shed needed. Large number of instruments turned into depot, and large number of new ones purchased. **10**, 25, 1067; **11**, 25, 1127; **12**, 23.

MISC. 14. ENGINEERS, CORPS OF — ENGINEER DIVISIONS (1901–12).

(For similar information for preceding years, see annual reports.

Northeast Division:
Col. G. L. Gillespie, 1901.
Col. C. R. Suter, 1901, 04–06.
Col. Amos Stickney, 1906–07.
Col. John G. D. Knight, 1907–10.
Col. Wm. M. Black, 1910–12.

Eastern Division:
Col. Amos Stickney, 1904–07.
Col. D. W. Lockwood, 1907–10.
Col. W. T. Rossell, 1910–12.

Chesapeake Division:
Col. W. A. Jones, 1904–05.

Southeast Division:
Col. P. C. Hains, 1903.
Col. J. B. Quinn, 1903–06.
Col. Amos Stickney, 1906.
Lt. Col. Dan C. Kingman, 1906–07, 1909–10; Col., 1911–12.

Gulf Division:
Lt. Col. H. M. Adams, 1904–05.
Lt. Col. Clinton B. Sears, 1905–07.
Col. E. H. Ruffner, 1907–09.
Lt. Col. L H. Beach, 1909–12.

Central Division:
Lt. Col. T. H. Handbury, 1902.
Col. G. J. Lydecker, 1903–08.
Col. C. E. L. B. Davis, 1908.
Col. W. T. Rossell, 1908–10.
Lt. Col. J. G. Warren, 1910.
Lt. Col. H. C. Newcomer, 1911–12.

Lakes Division:
Lt. Col. W. L. Fisk, 1908–09; Col., 1910–11.
Col. C. McD. Townsend, 1911–12.

Northwest Division:
Col. J. W. Barlow, 1901.
Col. S. M. Mansfield, 1901.
Lt. Col. O. H Ernst, 1901–05.
Lt. Col. W. H. Bixby, 1905–08.

Southwest Division:
Col. H. M. Robert, 1901.
Col. A. Stickney, 1901.

Western Division:
Col. A. Stickney.
Col. W. H. Bixby, 1908–11.
Lt. Col. C. L. Potter, 1911–12.

North Pacific Division:
Lt. Col. W. H. Heuer, 1901–04; Col., 1905–06.
Lt. Col. S. W. Roessler, 1907–08.
Lt. Col. John Biddle, 1909–12.
Lt. Col. Thos. H. Rees 1912.

Pacific Division:
Col. S. M. Mansfield, 1900.
Col. Jared A Smith, 1900–01.
Col. D. P. Heap, 1901–05.
Col. T. H. Handbury, 1905–06.
Col. W. H. Heuer, 1906–07.
Lt. Col. John Biddle, 1907–10; Col., 1911–12.
Lt. Col. Thos. H. Rees, 1912.

MISC. 15. FIELD SERVICE—ARIZONA.

ENGINEERS.
Lt. G. M. Wheeler. **R., 72,** 1124 (Arizona, Nevada, and Utah).
Lt. E. D. Thomas, 5th Cav. **R., 77,** 1449.
Lt. T. A. Toney, 6th Cav. **R., 78,** 1881.
Lt. C. F. Palfrey. **R., 80,** 2547; **81,** 2859; **82.** 2847.
Lt. G. J. Fiebeger. **R., 83,** 2404.
Lt. T. A. Bingham. **R., 84,** 2399; **85,** 2531.

MISC. 16. FIELD SERVICE—CALIFORNIA.

ENGINEERS.
Maj. W. A. Jones. **R., 83,** 2402; **84,** 2392.
Lt. T. L. Casey., **R., 85,** 2529; **87,** 314[illegible].
Lt. C. G. Lyman, 2d Cav., A. D. C. **R., 92** 3459; **93,** 4403; **94,** 3453.
Lt. J. L. Sehon, 20th Inf. **R., 95,** 4254.
Lt. J. F. Reynolds Landis, 1st Cav., A. D. C. **R., 95,** 4256; **96,** 4076.
Lt. J. D. Miley 5th Art. **R. 97,** 4136; **98,** 3783.

MISC. 17. FIELD SERVICE—CALIFORNIA AND OREGON.

ENGINEERS.
Chief of Engineers. **R., 66,** ii, 22.

MISC. 18. FIELD SERVICE—COLORADO.

ENGINEERS.
Chief of Engineers. **R., 97,** 547; **99,** 639; **00,** 718.

In charge:
Lt. J. L. Sehon, 20th Inf. **R., 97,** 4164.
Lt. J. R. Bennet, 16th Inf. **R., 99,** 3880; (Capt.) **00,** 5451.

MISC. 19. FIELD SERVICE—COLUMBIA.

ENGINEERS.
Chief of Engineers. **R., 80,** 249; **81,** 343; **82,** 329; **83,** 344; **84,** 349; **85,** 345; **88,** 317; **89,** 386; **90,** 355; **91,** 450; **92,** 424; **93,** 488; **94,** 443; **95** 497; **96,** 442; **97,** 547; **98,** 552; **99,** 639; **00,** 718.

In charge:
Lt. T. W. Symons. **R., 80,** 2549; **81,** 2863, **82,** 2851.
Lt. G. W. Goethals. **R., 83,** 2407; **84,** 2403.
Lt. W. C. Langfitt. **R., 87,** 3151; **88,** 2816.
Lt. L. A. Lovering, 4th Inf **R., 89,** 2878.
Maj. G. J. Lydecker. **R., 90,** 3599.
Capt. C. H. Clark, Ord. Dept. **R., 91,** 3945.
Maj. T. McCrea, 5th Art. **R., 92,** 3458; **93,** 4402; **94,** 3452.
Lt. J. L. Sehon, 20th Inf. **R., 95,** 4254; **96.** 4074.
Maj. T. H. Barry. **R., 97,** 4132.
Lt. J. B. Bennet, 7th Inf. **R., 98,** 3784.
Capt. H. P. McCain, 14th Inf. **R., 99,** 3879; **00,** 5450.

Assistants:
A. Downing. **R., 83,** 2410.
Lt. W. C. Brown, 1st Cav. **R., 81,** 2872.

MISC. 20. FIELD SERVICE—DAKOTA.

ENGINEERS.

Chief of Engineers. **R.**, **67**, 53; **74**, 123; **75**, 131; **76**, 123; **77**, 139; **78**, 147; **79**, 189; **80**, 247; **81**, 340; **82**, 328; **83** 343; **84**, 348; **85**, 377; **87**, 345.

In charge:

Capt. W. Ludlow. **R.**, **74**, ii, 626.

Reconnoissance, Black Hills. **74**, ii, 628; **75**, ii,1113; **76**, iii, 569.

Reconnoissance, Fort Carroll, Mont., to Yellowstone National Park. **76**, iii, 570.

Lt. E. Maguire. **R.** (Custer massacre), **76**, iii, 699; **77**, ii, 1337, 1338 (expedition against hostile Sioux, 1876); **78**, iii, 1671; **79**, 2359; **80**, 2509; **81**, 2843; (Capt.) **82**, 2843.

Lt. H. S. Taber. **R.**, **83**, 2392; **84**, 2387.

Lt. J. Biddle. **R.**, **85**, 2527; **87**, 3149.

Assistants:

Prof. N. H. Winchell. Geologist and botanist. **R.**, **74**, ii, 630; **75**, ii, 1131, 1172.

G. B. Grinnell. Paleontology and zoology. **74**, ii, 632, 633; **75**, ii, 1177; **76**, iii, 634, 657.

Prof. J. M. Coulter. **R.**, **75**, ii, 1173.

R. P. Whitfield. New fossils **R.**, **75**, ii, 1202 **76**, iii, 694.

Lt. R. E. Thompson, 6th Inf. **R.**, **76**, iii, 631.

E. S. Dana. Geological report. **76**, iii, 657.

Lt. E. J. McClernand, 2d Cav. **R.**, **77**, ii, 1361.

Lt. G. D. Wallace, 7th Cav. **77**, ii, 1376 (Yellowstone expedition).

Sergt. J. E. Wilson. **R.**, **77**, ii, 1378 (Yellowstone expedition); **80**, 2530.

Lt. L. R. Hare, 7th Cav. **R.**, **78**, iii, 1672.

Asst. Surg. V. Havard, U. S. A. Botany. **R.**, **78**, iii, 1681; **80**, 2513.

Lt. O. F. Long, 5th Inf. **R.**, **78**, iii, 1688 (journal of marches under Col. N. A. Miller).

Topographical Asst. J. J. Durage. Survey. military reservation, Fort Keogh. **R.**, **79**, iii, 2363.

Lt. W. Hoffman, 11th Cav. Reconnoisance, Moreau, or Owl, River, Dakota. **R.**, **79**, iii, 2367.

A. A. Surg. C. E. McChesney. Mammals and birds. **R.**, **79**, iii, 2371.

W. W. Payne. Astronomy **R.**, **81**, 2844.

MISC. 21. FIELD SERVICE—MISSOURI.

ENGINEERS.

In charge:

Lt. E. H. Ruffner. **R.**, **72**, 1121; **73**, 1221; **74**, ii, 622 (completion of military road, Santa Fe to Taos, N. Mex.), 625; **75**, ii, 1233; **76**, iii, 718, 724 (lines of communication between southern Colorado and northern New Mexico); **77**, ii, 1399, 1401 (survey of headwaters of Red River), 1410 (meteorology), 1422 (botany), 1431 (geology); **78**, iii, 1749. **79**, 2329.

Maj. J. W. Barlow. **R.**, **74**, ii, 607.

Lt. T. N. Bailey. **R.**, **81**, 2837 (district of Missouri and New Mexico; **82**, 2833 (district of Missouri and New Mexico).

Lt. O. M. Carter. **R.**, **83**, 2389 (district of Missouri and New Mexico); **84**, 2383 (district of Missouri and New Mexico)

Capt. W. L. Marshall. **R.**, **94**, 3451; (Maj.) **95**, 4253; **96**, 4073; **97**, 4131.

Capt. C. E. Gillette. **R.**, **92**, 3457; **93**, 4401.

Assistants:

T. H. Safford. **R.**, **73**, 1243 (difference of longitude, Denver, Colo., and Pueblo, Colo.).

Lt. G. S. Anderson, 6th Cav. **R.** (survey of wagon road, Fort Garland, Colo., to Fort Wingate, N. Mex.), **76**, iii, 739.

Lt. T. M. Woodruff, 5th Inf. **R.**, **77**, ii, 1409, 1467 (insects).

Lt. C. A. H. McCauley, 3d Art. **R.**, **78**, iii, 1750 (San Juan reconnoissance; entomology).

Prof. A. Gray. **R.**, **78**, iii, 1832 (botany).

T. S. Brandegee, C. E. **R.**, **78**, iii, 1841 (botany).

Prof. C. T. Thomas. **R.**, **78**, iii, 1843 (orthoptera).

Prof. H. Strecker. **R.**, **78**, iii, 1847 (lepidoptera).

Asst. Surg. C. Smart, U. S. A. **R.**, **79**, iii, 2331 (analysis of Pagosa Spring, Colo.).

Capt. H. W. Lawton, 4th Cav. **R.**, **83**, 2391.

MISC. 22. FIELD SERVICE—MISSOURI.

ENGINEERS.

In charge:

Maj. J. W. Barlow. **R.**, **74**, ii, 607.

Maj. W. E. Merrill (Bvt. Col.). **R.**, **68**, 1196.

Maj. G. L. Gillespie. **R.**, **75**, ii, 1112; **76**, iii, 565.

Capt. G. J. Lydecker. **R.**, **77**, ii, 1135; **78**, iii, 1669.

Capt. J. F. Gregory. **R.**, **79**, iii, 2315; **80**, 2601; **81**, 2829; **82**, 2827; **83**, 2383.

Maj. T. H. Handbury. **R.**, **84**, 2379; **87**, 3145.

Capt. W. L. Marshall. **R.**, **88**, 2813; **89**, 2875; **90**, 3600; **91**, 3493.

MISC. 23. FIELD SERVICE—NEW MEXICO.

ENGINEERS.

Chief of Engineers. **R.**, **79**, 189; **81**, 340.

In charge:

Lt. E. H. Ruffner. **R.**, **79**, 2343

Lt. C. A. Stedman, 9th Cav. **R.**, **79**, 2343. Reconnoissance, Santa Fe to Fort Stanton, **79**, iii, 2348. North Star Road, Fort Bayard to the canyon on the Black R., **79**, iii, 2351.

Lt. T. N. Bailey. **R.**, **81**, 2837; **82**, 2833 (Dept. of Missouri and district of New Mexico).

2d Lt. R. T. Emmet. **R.**, **81**, 2841.

MISC. 24. FIELD SERVICE—PACIFIC DIVISION.

ENGINEERS.

Chief of Engineers. **R.**, **67**, 53; **68**, 76; **75**, 131; **76**, 124; **77**, 130; **78**, 148; **79**, 189; **80**, 248; **81**, 340; **82**, 328; **83**, 343; **88**, 317; **89**, 386; **90** 354; **91**, 449; **99**, 639; **00**, 718.

In charge:

Maj. R. S. Williamson (Bvt. Lt. Col.). **R.**, **68**, 870.

Lt. J. C. Mallery. **R.**, **75**, ii, 1238; **76**, iii, 750; **77**, ii, 1441; **78**, iii, 1878.

Capt. J. H. Coster, 8th Cav. **R.**, **78**, iii, 1878.

Lt. C. F. Palfrey. **R.**, **79**, iii, 2307.

Capt. W. A. Jones. **R.**, **80**, 2543; **81**, 2855; (Maj.) **82**, 2845.

Lt. J. E. Runcie, 1st Art. **R.**, **88**, 2817; **89**, 2879; **90**, 3603; **91**, 3947.

Capt. C. L. Potter (Lt. Col. U. S. Vols.). **R.** (Dept. of the Pacific), **99**, 3871 (Manila).

Assistants:

Lt. E. D. Thomas, 5th Cav. **R.**, **76**, iii, 753; **77**, 1448.

Lt. W. G. Haan, 3d Art. **R.**, **99**, 3875 (Manila).

Lt. W. P. Wooten. **R.**, **99**, 3876 (Manila).

Capt. F. R. Shunk. **R.**, **99**, 3878 (Manila).

MISC. 25. FIELD SERVICE—PHILIPPINES.

ENGINEERS.

Chief of Engineers. **R.**, **99**, 639; **00**, 718.

In charge:

Capt. C. L. Potter. **R.**, **99**, 3871.

Capt. J. Biddle. **R.**, **00**, 5445.

Maj. J. Biddle, 1901.

Maj. C. B. Sears, 1901.

Assistants:

Lt. W. G. Haan, 3d Art. **R.**, **99**, 3875.

2d Lt. W. P. Wooten. **R.**, **99**, 3876.

Capt. F. R. Shunk. **R.**, **99**, 3878.

1st Lt. F. W. Altstaetter, 1901.

Capt. C. F. O'Keefe (36th Inf. U. S. V.), 1901.

1st Lt. A. R. Baskette (37th Inf. U. S. V.), 1901.

2d Lt. G. E. Stewart (19th U. S. Inf.), 1900–01.

Special reports:

Capt. G. A. Zinn, 1901 (northern Luzon).

1st Lt. J. C. Oakes, 1901 (southern Luzon).

1st Lt. S. A. Cheney, 1901 (southern Luzon).

Operations:

1900–01. First battalion organized in Manila from old companies A, B, and E, G. O. No. 22, A. G. D., Maj. C. B. Sears, commanding. Routine office work; large quantity of tools, lumber, and other material purchased; 8,800 maps distributed throughout division; about 700 miles road in Luzon repaired and rebuilt, including bridges and fences. Lack of sufficient number of officers and troops a serious handicap. **01**, 43, 975.

MISC. 26. FIELD SERVICE—PLATTE.

ENGINEERS.

Chief of Engineers. **R.**, **67**, 53; **68**, 77; **74**, 123; **75**, 131; **76**, 123; **77**, 130; **78**, 147; **79**, 188; **80**, 247; **81**, 340; **82**, 327; **83**, 342; **84**, 348; **85**, 377; **88**, 317; **89**, 386; **90**, 354; **91**, 449; **92**, 424; **93**, 488; **99**, 639.

In charge:

Lt. R. W. Petriken. **R.**, **68**, 1197.

Capt. W. A. Jones. **R.**, **74**, ii, 620.

Capt. W. S. Stanton. **R.**, **75**, ii, 1231; **76**, iii, 704; **77**, ii, 1381; **78**, iii, 1705; **79**, iii, 2319; **80**, 2505; **81**, 2835.

Lt. D. C. Kingman. **R.**, **82**, 2831; **83**, 2387; **84**, 2381; **85**, 2525.

Lt. H. M. Chittenden. **R.**, **88**, 2818.

Lt. F. W. Roe, 3d Inf. **R.**, **89**, 2877.

Lt. C. A. Worden, 7th Inf. **R.**, **90**, 3601. **91**, 3946; **92**, 3459; (Capt.) **93**, 4403.

MISC. 27. FIELD SERVICE—PORTO RICO, ENGINEERING OPERATIONS.

APPROPRIATIONS.

1900, [1] $2,385
1900, [2] 500
Total, 2,885

ENGINEERS.

Chief of Engineers. **R., 00,** 718.
In charge. Capt. W. V. Judson. **R., 00,** 5449.

MISC. 28. FIELD SERVICE—TEXAS.

ENGINEERS.

Chief of Engineers. **R., 77,** 130; **78,** 148; **84,** 348; **85,** 377.

In charge:

Capt. J. F. Gregory. **R., 77,** ii, 1439; **78,** iii, 1873.
Maj. W. R. Livermore. **R., 84,** 2391; **85,** 2521.

MISC. 29. ENGINEERS, CORPS OF—SERVICE OF OFFICERS ABROAD AND IN THE FIELD.

Lt. E. M. Adams. **03,** 30.
Lt. F. W. Altstaetter. **01,** 103.
Lt. W. J. Barden. **01,** 95; **02,** 49.
Maj. J. Biddle. **01,** 58.
Maj. Wm. M. Black. **01,** 52.
Lt. E. I. Brown. **01,** 112; **02,** 53; **03,** 27.
Lt. L. Brown. **01,** 110; **02,** 52; **03,** 26.
Lt. H. Burgess. **01,** 96; **02,** 50.
Capt. E. Burr. **01,** 63.
Lt. W. G. Caples. **01,** 117; **02,** 50; **03,** 33.
Capt. J. B. Cavanaugh. **01,** 94; **02,** 49.
Lt. S. A. Cheney. **01,** 102; **02,** 50.
Capt. H. M. Chittenden. **01,** 70.
Lt. Wm. D. Connor. **01,** 97.
Capt. Spencer Cosby. **01,** 91; **03,** 26.
Capt. Wm. E. Craighill. **01,** 76; **02,** 47.
Lt. Col. C. E. L. B. Davis. **02,** 45; **03,** 24.
Lt. E. J. Dent. **01,** 117; **02,** 59; **03,** 33.
Lt. C. P. Echols. **01,** 93.
Engineer Troops. **01,** 80.
Lt. Col. O. H. Ernst. **01,** 46.
Lt. H. B. Ferguson. **01,** 104; **02,** 52.
Capt. G. D. Fitch. **01,** 66.
Capt. C. A. F. Flagler. **01,** 85; **02,** 47.
Lt. A. H. Fries. **01,** 112; **02,** 54; **03,** 27.
Capt. D. D. Gaillard. **01,** 71.
Brig. Gen. G. L. Gillespie. **01,** 45.
Maj. G. W. Goethals. **01,** 57.
Col. P. C. Hains. **01,** 45.
Lt. W. T. Hannum. **03,** 35.
Capt. W. W. Harts. **01,** 89; **02,** 47; **03,** 25.
Maj. H. F. Hodges. **01,** 61; **02,** 46.
Lt. G. M. Hoffman. **01,** 96.
Capt. E. Jadwin. **01,** 90.
Capt. H. Jervey. **01,** 83; **02,** 47; **03,** 25.
Lt. H. C. Jewett. **03,** 34.
Lt. E. N. Johnson. **01,** 115; **02,** 58; **03,** 31.
Lt. R. Johnston. **01,** 95.
Capt. W. V. Judson. **01,** 83.
Capt. C. Keller. **03,** 26.
Lt. W. Kelly. **01,** 113; **02,** 55; **03,** 28.
Lt. R. D. Kerr. **01,** 112.
Capt. J. E. Kuhn. **01,** 76.
Capt. W. C. Langfitt. **01,** 68.
Lt. W. H. Lee. **01,** 116.
Lt. Col. W. R. Livermore. **01,** 50; **02,** 45.
Capt. E. W. Van C. Lucas. **01,** 82.
Lt. Col. Wm. Ludlow. **01,** 49.
Lt. G. R. Lukesh. **01,** 115; **02,** 57; **03,** 30.
Maj. J. L. Lusk. **01,** 56.
Lt. E. M. Markham. **01,** 114; **02,** 56; **03,** 29.
Maj. G. McDerby. **01,** 55.
Capt. R. McGregor. **01,** 90; **02,** 48; **03,** 25.
Lt. Wm. A. Mitchell. **03,** 34.
Capt. J. J. Morrow. **01,** 93; **02,** 48; **03,** 26.
Lt. J. C. Oakes. **01,** 100.
Lt. C. W. Otwell. **02,** 58; **03,** 31.
Lt. E. D. Peek. **01,** 116; **02,** 59; **03,** 32.
Lt. G. B. Pillsbury. **01,** 115; **02,** 56; **03,** 29.
Lt. J. H. Poole. **03,** 32.
Capt. C. L. Potter. **01,** 79.
Lt. L. H. Rand. **01,** 114; **02,** 56; **03,** 29.
Capt. T. H. Rees. **01,** 78.
Capt. C. S. Riche. **01,** 78.
Maj. C. B. Sears. **01,** 51; **02,** 45; **03,** 24.
Capt. J. Sewell. **01,** 92.
Lt. C. O. Sherrill. **01,** 115; **02,** 58; **03,** 31.
Capt. F. R. Shunk. **01,** 81.
Capt. Wm. L. Sibert. **01,** 74.
Lt. J. R. Slattery. **01,** 115; **02,** 57; **03,** 30.
Lt. G. R. Spalding. **01,** 116; **02,** 59; **03,** 33.
Lt. H. W. Stickle. **01,** 113.
Lt. Wm. P. Stokes. **03,** 31.
Maj. C. McD. Townsend. **03,** 24.
Lt. H. L. Wigmore. **02,** 58; **03,** 31.
Lt. A. Williams. **01,** 117; **02,** 60; **03,** 34.
Capt. E. E. Winslow. **01,** 84.
Lt. J. A. Woodruff. **01,** 112; **02,** 54; **03,** 28.
Lt. W. P. Wooten. **01,** 109.
Capt. G. A. Zinn. **01,** 67; **02,** 46.

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[1] Civilian assistants, **00,** 5450.

[2] Equipment, Engr. Troops, **00,** 5450

MISC. 39. CORPS OF ENGINEERS—DUTIES OF OFFICERS.

Each annual report of the Chief of Engineers refers briefly to the character of the duties performed during the preceding fiscal year by the members of the Corps of Engineers, U. S. Army.

From 1901–1912 alone the time of the members of the corps has been distributed according to the following classifications:

Absence (sickness, leave, etc.).
Adjutant General's Office, U. S. Army.
Agriculture, Department of, buildings for.
Aid-de-camp.
Alaska, Board of Road Commissioners in.
Alaska, road work in.
Army Field Engineer School, Fort Leavenworth, Kans.
Army War College, on duty.
Assistant Chief Engineer Officer, military mapping, Philippine Islands.
Assistant Chief Engineer Officer, military division.
Assistant to Engineer Commissioner, District of Columbia.
Assistants to the Chief of Engineers.
Atlantic Division, Engineer Officer.
Battalion of Engineers, Second.
Board for improvement of harbor at Guam.
Board of Engineers.
Board of Ordnance and Fortification.
Board of road commissioners in Alaska.
Building for Department of Agriculture.
Buildings for Government Printing Office.
Building for Soldiers' Home.
Building for War College.
Building for Washington Barracks.
California Débris Commission.
Changing stations.
Chief Engineer officer, military department.
Chief Engineer officer, military division.
Chief Engineer officer, Pacific Division.
Chief Engineer officer, Philippine Division.
Chief Engineer officer, Southwestern Division.
Chief of Engineers.
Chief of Engineers, assistants to the.
Chief of Engineers, office of.
Columbia, Department of the.
Command of Engineer troops, Hawaiian Islands
Cornell University, under instruction at.
Cuba.
Cuban affairs.
Cuba, Department of.
Cuba, en route from.
Department of California, Engineer officer.
Department of Cuba.
Department of the Columbia.
Department of the East.
Department of the East, Engineer officer.
Department of the Lakes, Engineer officer.
Department of the Missouri, Engineer officer.
District of Columbia, assistants to Engineer Commissioner.
District of Columbia, Engineer Commissioner.
District of Columbia, government of.
Division Engineer.
Division of the Philippines.
East, Department of the.
Engineer Commissioner, District of Columbia.
Engineer Commissioner, District of Columbia, assistants to.
Engineer Department.
Engineer Department at Willets Point.
Engineer district, under instructions.
Engineer officer, Atlantic Division.
Engineer officer, Department of California.
Engineer officer, Department of Missouri.
Engineer officer, Department of the East.
Engineer officer. Department of the Lakes.
Engineer officer, Department of Texas.
Engineer School.
Engineer School of Application.
Engineer secretary to lighthouse board.
En route from Cuba.
En route from Philippine Islands.
En route to Philippine Islands.
First Battalion of Engineers.
Fortifications.
Fortifications at Guantanamo Bay, Cuba.
Fortification work in the Hawaiian Islands.
Fortification work in the Philippine Islands.
Fortification work in the United States.
Ft. Bayard, N. Mex., general hospital.
Ft. D. A. Russel, Wyo., troops.
Ft. Leavenworth, Kans., post of.
Ft. Leavenworth, Kans., Service School, on duty.
Ft. Leavenworth, Kans., troops.
Ft. Mason, Cal., post of.
Ft. Recovery, monument at.
Ft. Riley Military Reservation.
Ft. Totten, post of.
Ft. Washakie Military Road.
General Hospital, Ft. Bayard, N. Mex.
General Staff, Philippine Division.
Government of the District of Columbia.
Government Printing Office, buildings for.
Graduating leave of absence.
Guam, harbor at, board for improvement of.
Guantanamo Bay, Cuba, fortification at.
Hawaiian Islands, Engineer troops, command of
Hawaiian Islands, fortification work in.
Hawaiian Islands, troops.
Infantry and Cavalry School and Staff College.
Inland Waterway Commission
International Congress.
Isthmian Canal Commission.
Leave of absence.
Lighthouse Board.
Lighthouse Board, engineering secretary to.
Lighthouse duty.
Lighthouse Establishment.
Maine, the battleship, removal of.
Maneuver division, troops.
Military attachés with Russian and Japanese Armies.
Military attachés, Tokio, Japan.
Military attaché to United States legations.
Military Department, chief Engineer officer.
Military Division.
Military Division, assistant chief Engineer officer.
Military Division, chief Engineer officer.

Military mapping in the Philippine Islands.
Mississippi River Commission.
Mississippi River improvement.
Missouri River Commission.
Monument at Ft. Recovery.
National rifle competition.
Northern and northwestern lakes, survey of.
Office, Chief of Staff.
Office of the Chief of Engineers.
On duty, Army War College.
On duty, Service School, Ft. Leavenworth, Kans.
Ordnance and Fortification, Board of.
Pacific Coast, troops.
Pacific Division, chief Engineer officer.
Panama Canal.
Panama Canal, defense of, preparation of plans.
Philippine Division, chief Engineer officer.
Philippine Division, general staff.
Philippine Islands, en route from.
Philippine Islands, en route to.
Philippine Islands, fortification work.
Philippine Islands, troops.
Philippine Islands, military mapping in.
Philippine Islands, military mapping, assistant chief Engineer officer.
Philippines, The Division of.
Post of Ft. Leavenworth.
Post of Ft. Mason, Cal.
Post of Ft. Totten.
Post of Washington Barracks.
Preparation plans, defense of Panama Canal.
Provisional General Staff.
Public Buildings and Grounds.
Removal of the battleship *Maine*.
River and harbor works.
Road work in Alaska.
Russian and Japanese Armies, military attachés with.
School of the Line.
Second Battalion of Engineers.
Sick, absent.
Soldiers' Home, building for.
Southwestern Division, chief Engineer officer.
State, War, and Navy Building, superintendent of.
Superintendent, State, War, and Navy Building.
Survey duty, Yosemite National Park.
Survey, northern and northwestern lakes.
Texas, Department of, Engineer officer.
Third Battalion of Engineers.
Tokyo, Japan, military attaché.
Troops at Vancouver Barracks, Wash.
Troops, Pacific coast.
Troops, Ft. D. A. Russel, Wyo.
Troops, Ft. Leavenworth, Kans.
Troops, maneuver division.
Troops, Philippine Islands.
Troops, Hawaiian Islands.
Twelfth International Congress of Navigation.
Under instruction at Cornell University.
Under instruction in Engineer district.
United States Engineer School.
United States, fortification work.
United States legation, military attaché to.
United States Military Academy.
Vancouver Barracks, Wash., troops at.
Vicksburg National Military Park.
War College, building for.
War College Board.
Washington Aqueduct.
Washington Barracks, building for.
Washington Barracks, post of.
Willets Point, Engineer Department.
Yellowstone National Park.
Yosemite National Park, survey duty.

MISC. 31. POSTS—SUBPOST OF FORT FOOTE, MD.

1901–02. Situated on Maryland bank of the Potomac R., 8 miles s. of the city of Washington. Used for drill purposes. Buildings are old and in a bad state of repair. 02, 795.

1902–03. Minor repairs to wharf, road, and water supply. 03, 18, 685.

MISC. 32. POSTS—FORT TOTTEN, N. Y. (INCLUDING U. S. ENGINEER SCHOOL, BATTALION OF ENGINEERS, AND ENGINEER DEPOT), 1866-1901.

(See Misc. 8 on p. 2045 of this index.)

CONTRACTS.

1897. 30 m. of single-conductor cable and 9 m. 7-core cable, $24,916.50; 26 rotary transformers, $3,965.52; 26 oil engines, complete, $17,316; 26 electric storage batteries, complete, $7,384; 28 switchboards, complete, $6,867.84. **98**, 576

1898. 46 operating boxes, complete, $1,297.20, **98**, 576; 25 m. multiple cable, $47,500; 100 m. single cable, $36,500; 75 m. single cable, $26,212.50; 100 m. multiple cable, $159,500; 1,600 torpedoes, complete $180,000; 7 wooden pontoon boats, complete, $1,372; 1 fireproof instrument repair shop, $7,550. **99**, 682.

1899. 6 yawl boats, complete, $702; white-pine lumber for bridge equipage, $1,333.47; 18 wooden pontoon boats, complete, $4,050; 2 frame storage sheds, $745 each. **99**, 683. Repairs to wharf, $2,560.75. **00**, 1068.

1900. 50,000 brass washers, 78¢ per pound; compound plugs and glands, $1,689.66; 12,000 fuses, 8¢; 8,000 7″ and 4,000 9″ wire cut-outs, 6¢; 1,050 aluminum metal cases, $2.10; 66,000′ No. 16 kerite insulated wire, $11.50, and 26,400′ No. 12, $23.50 per 1,000′; 5 slow-speed rotary transformers, $174 each; 6 oil engines, 4-horsepower, $660; 6 electric switchboards, $380; 500 thermometers, 66¢; 100 hygrometers, $2.45; 18,138′ b. m. Oregon white-pine timber, $50 M; 200 500-pound anchors, $1,290; 400 cut-out boxes, $760; 7,500 split keys for shackles, $45; 1,100 split keys for mines, $49.50; 1,700 mine and 2,600 anchor shackles and 3,500 mooring sockets at 60¢ each. **00**, 1068.

ENGINEERS.

Chief of Engineers. R., **66**, ii, 19; **67**, 15; **68**, 21; **69**, 20; **70**, 28; **71**, 26; **72**, 26; **73**, 27; **74**, 32 **75**, 33, 131; **76**, 32, 122; **77**, 28; **78**, 32; **79**, 30 **80**, 60; **81**, 61; **82**, 61; **83**, 56; **84**, 65; **85**, 52; **86**, 52; **87**, 12; **88**, 8; **89**, 12; **90**, 10; **91**, 15; **92**, 19; **93**, 17; **94**, 17; **95**, 18; **96**, 6; **97**, 4; **98**, 5; **99**, 5, 8; **00**, 35, 36; **01**, 38.

In charge:

Capt. F. Harwood, 1866.

Lt. Col. H. L. Abbot, 1866-85. R., **80**, 297; **81**, 419; **82**, 443; **83**, 389; **84**, 425; **85**, 425.

Lt. Col. J. C. Duane, 1868.

Lt. Col. C. B. Comstock, 1886. R., **86**, 471.

Lt. Col. W. R. King, 1886-95. R., **86**, 489; **87**, 419; **88**, 345; **89**, 467; **90**, 389; **91**, 537; **92**, 473; **93**, 647; **94**, 467; **95**, 521.

Maj. W. T. Rossell, 1896.

Maj. J. G. D. Knight, 1896-1900. R., **96**, 451; **97**, 559; **98**, 563; **99**, 650; **00**, 1045.

Maj. W. M. Black, 1901. **01**, 927.

Battalion of Engineers—Company A—In charge:

Capt. A. Stickney, 1868.
Capt. A. Mackenzie, 1869-73.
Lt. W. T. Rossell, 1874.
Capt. J. W. Cuyler, 1875.
Capt. J. A. Mercer, 1876.
Capt. T. H. Handbury, 1877-79.
Capt. J. B. Quinn, 1880.
Lt. F. V. Abbott, 1881.
Capt. C. W. Raymond, 1882.
Capt. E. H. Ruffner, 1883-84.
Capt. J. G. D. Knight, 1885-87.
Capt. S. W. Roessler, 1888-89.
Capt. C. B. Sears, 1890.
Capt. W. A. Fisk, 1894-95.
Capt. S. W. Roessler, 1896-97.
Capt. W. C. Langfitt, 1898.
Capt. F. R. Shunk, 1899.

Company B—In charge:

Capt. A. H. Burnham, 1868-70.
Capt. W. R. King, 1871-75.
Lt. J. B. Quinn, 1876.
Capt. A. M. Miller, 1877-81.
Capt. J. H. Willard, 1882-83.
Capt. C. F. Palfrey, 1884.
Capt. T. N. Bailey, 1885.
Lt. H. M. Chittenden, 1886.
Capt. E. Maguire, 1887-88.
Capt. R. L. Hoxie, 1889-90.
Capt. W. T. Rossell, 1894-95.
Capt. W. C. Langfitt, 1896-97.
Capt. S. W. Roessler, 1898.
Capt. W. L. Sibert, 1899.

Company C—In charge:

Capt. A. H. Holgate, 1868.
Capt. O. H. Ernst, 1869-70.
Capt. W. C. Raymond, 1871-72.
Capt. J. C. Post, 1873.
Capt. W. R. Livermore, 1874-77.
Capt. J. F. Gregory, 1878-79.
Capt. J. C. Mallery, 1880-83.
Capt. P. M. Price, 1884-85.
Lt. W. C. Langfitt, 1886.
Capt. E. Bergland, 1887-90.
Capt. W. M. Black, 1894-95.
Capt. T. A. Bingham, 1896.
Capt. G. D. Fitch, 1897.
Capt. E. Burr, 1898-99.
Capt. G. D. Fitch, 1899.
Capt. Thos. H. Rees, 1900.
Capt. H. Jervey, 1900.

Company D—In charge:

Capt. S. M. Mansfield, 1867-70.

Practically abandoned in 1871; exists only in name, and is commanded by the battalion adjutant.

Maj. J. Millis, 1898-1900.

Company E—In charge:

Capt. W. Ludlow, 1867.

Capt. J. W. Cuyler, 1868.
Capt. P. C. Hains, 1869–70.
Capt. O. H. Ernst, 1872–78.
Capt. C. W. Raymond, 1880–81.
Maj. W. S. Stanton, 1882–85.
Capt. P. M. Price, 1886–88.
Capt. G. McC. Derby, 1889–90.
Capt. J. L. Lusk, 1894–97.
Maj. G. W. Goethals, 1898–1900.

Assistants.

Reports:

Capt. J. B. Quinn. **80,** 302; **81,** 425.
2d Lt. W. L. Fisk. **80,** 302, 312, 314; (1st Lt.) 318, 319.
Lt. J. C. Mallery. **80,** 305, 307; (Capt.) **84,** 430.
Lt. E. Griffin. **81,** 425, 429; **82,** 448; **83,** 394.
Lt. J. H. Willard. **81,** 431, 433, 449, 452; **82,** 449, 452.
Lt. W. H. Bixby. **83,** 395, 398.
Lt. J. L. Lusk. **84,** 429; **85,** 432.
Lt. J. Millis. **84,** 431.
Lt. H. F. Hodges. **84,** 434; **85,** 432.
Capt. S. W. Roessler. **85,** 455; **86,** 477; **87,** 425, 433; **88,** 360, 364; **89,** 495; **90,** 413, 419.
Lt. J. R. Warren. **88,** 360; **89,** 485; **91,** 553.
Lt. I. Hale. **88,** 370.
Lt. C. Harding. **90,** 418.
Lt. A. M. D'Armit. **90,** 421; **91,** 565; **92,** 490.
Lt. H. Jervey. **91,** 559.
Lt. R. McGregor. **92,** 484.
Lt. J. Morrow. **95,** 532; **96,** 455.
Lt. W. E. Craighill. **96,** 460; **97,** 564.
Lt. W. V. Judson. **97,** 568.

Summary of reports:

1865. Place constituted an engineer post and depot, selected as the headquarters of the Battalion of Engineers, and as the depot for the storage of the Engineer material. **68,** 21.

1867. By act of July 28, 1866, the 5 companies of the Corps of Engineer troops were constituted a Battalion of Engineers to be composed of 752 enlisted man. Three companies stationed at Willets Point, N. Y.; 1 at Jefferson Barracks, Mo.; and 1 en route for Yerba Buena Island, Cal. Act of July 13, 1866, separated the Military Academy from the Corps of Engineers. It had been a part of that corps, by law, for more than 64 years. **67,** 15.

1868. Constr. of quarters in progress. In compliance with G. O. 56, dated Aug. 1, 1866, schools were opened for the enlisted men. **68,** 21.

1869. Permanent hospital completed; work on other buildings. Survey of the battlefield of Gettysburg in progress under command of Lt. T. Turtle. **69,** 20.

1870. By au. of the Sec. of War, post constituted the torpedo school of the Army; experimental work in progress. Work on buildings in progress. **70,** 29.

1871. G. O. 122, series of 1870, reduced the strength of the 5 companies constituting the battalion, June 30, 1871, to 12 officers and 303 enlisted men. Companies A, B, and C stationed at Willets Point. Company E, composed of the detachment heretofore kept at the Military Academy to aid in instructing the cadets, increased to a full company and stationed at West Point. Company D practically disbanded by the reduction of the battalion. **71,** 27.

1877. Table giving a synopsis of the recruiting service and of desertions from June 30, 1865, to June 30, 1877. **77,** 28.

1880. New astronomical observatory completed. Total cost, $842.49. $9,000 allotted for quarters; work in progress; general repair of buildings. Statement of receipts and issues of materials. Calcium chloride used to dry the air in the storerooms; formula given of the solution used. **80,** 322; **81,** 453; **82,** 481

1881. A field astronomical observatory erected in 1868; regular series of meteorological observations and practice in making reconnoissance and surveys begun in that year. Use of photography for duplicating maps in the field begun in 1873. Tidal and current measurements begun in 1871. **81,** 423.

1882. Willets Point transferred from an ordinary military post into the Engineer School of Application. **82,** 446.

1883. Photographic laboratory built. **83,** 403.

1884. Sapping or molding shed built; cost, $6,385. **84,** 455.

1886. Board of officers constituted by S. O. 187, A. G. O., Aug. 17, 1885, to consider and report upon the questions of water supply, sewers, and hospital accommodations at Willets Point. **R. 86,** 484. (Col. Q. A. Gillmore, Corps of Engineers, Lt. Col. H. G. Hodges, Q. M. G., and Maj. D. L. Huntington, surgeon, U. S. A.) Plan and est. for brick barrack at Willets Point. **86,** 486.

1888. The Quartermaster's Department completed the water supply and sewerage systems, necessary plumbing for sanitary purposes in barracks and quarters, and the double set of officers' quarters and the new hospital building. **88,** 345. Experiments in electro-magnetism on a large scale made with 2 15" guns, a large quantity of torpedo cable, and a dynamo (photograph). **88,** 354.

1889. Laboratory for enlisted men built, target range improved and extended, and repairs made to buildings. A post canteen and a combined mess for enlisted men established. A detachment of officers and soldiers sent to Johnstown, Pa., on June 5, 1889, to assist in bridging streams. **89,** 467. Experiments—Tests of explosives, crater gauge, pressure gauge, range finders, transition indicators, Sim's torpedo, with results of tests and photographs. $200,000 app. for torpedoes for H. defense. Statement of funds and ests. required for the following year. **89,** 478. Report of board of officers upon torpedo material, with recom.—Reports on shackles and mooring rope, bronze torpedo case, cut-off boxes, operating box, and on a system of firing without the automatic switching on of the firing battery; McIntire jointer and tests of fuses. **89,** 489. Board of Engineers constituted by S. O. 31, to witness a test of the "automobile controllable torpedo" of J. H. Patrick; report giving description of torpedo and trials witnessed. **89,** 497. (Maj. W. R. King, Capt. S. W. Roessler, and Lt. I. Hale.)

1890. Experiments—Trials of Sim's fish torpedo; torpedo drills; tests of explosives; crater gauge; sensitiveness of explosives; tests of insulated cable; self-acting mine; and building materials (photographs). **90,** 401, 413.

1891. New building for Engineer models completed; cost, $8,000. $9,000 allotted for guardhouse and $1,692.67 allotted for fire engines by the Quartermaster's Department. The title of "Engineer School of Application" changed, Sept. 24, 1890, by the Acting Sec. of War to "U. S. Engineer School." Lectures delivered—Foundations under difficulties, Mr. John Anderson; English engineering in Egypt, Dr. R. W. Raymond; Improvement of tidal rivers, Maj. C. W. Raymond; Concrete breakwaters, Capt. F. A. Mahan. Experiments—Sim's fish torpedo, tests of explosives, mortar practice with wooden projectiles described, building materials tested, and other torpedo experiments made. **91,** 539, 553.

1892. Fireproof storehouse for pontoon, siege, and torpedo materials nearly completed. Small steam tug for planting torpedoes completed. Cable storage tank built, and minor work. Property cared for and repaired. Sims-Edison fish torpedo delivered and tested. Tests of cables, circuit closers, self-acting mine mechanism, new form of electric current meter, building stone and cement, electric fuses, and other special tests made. **92,** 479, 490.

1893. Term of enlistment discussed; advantages to be gained by reducing it from 5 to 3 years. **93,** 652. Experiments—Artificial heat used in drying mining casemates, 36 drums of cable received from England and tested; trials of Sims-Edison fish torpedo continued. **93,** 656.

1894. Experiments—Blasting concrete platforms, explosives, Sims-Edison torpedo, building materials; minor tests. **94,** 477.

1895. New barrack building completed, quarters moved, work on retaining wall around ice pond. Contracts for submarine mining material completed, cable tested. Experiments—Explosives for breaking ice to improve navigation, Sims-Edison torpedo, pressure gauge improved; minor tests. **95,** 529.

1896. Old frame barrack and stable removed, new magazine rifle, U. S. model 1892, caliber .30, issued to the troops in July, 1895. Engineer models shipped to Atlanta, Ga., for the War Department exhibit. **96,** 451, 465.

1897. 4 batteries of Artillery came to the post for Artillery practice. Disputes concerning the commanding officer while in camp. **97,** 560.

1898. New regulations for the government of the U. S. Engineer School given. **98,** 565. On Apr. 4, 1898, Sec. of War au. the increase of the battalion of Engineers from 500 to 702 enlisted men. Detachments for submarine mine defense of harbors sent out during Apr., 1898, from the 3 companies. Company D (a skeleton company for several years) was reorganized. Company A serving with troops at the Philippine Islands. Companies C and E serving with the army in Cuba. Company D detached for submarine mining duty at 19 harbors on the Atlantic, Gulf and Pacific coasts. Company B engaged at the Engineer depot at Willets Point receiving, storing, and distributing the vast amount of torpedo material, pontoon equipage, siege materials, and instruments purchased and distributed from the depot. **98,** 6. Submarine mine material—Lists of materials received with statement of funds, abstracts of proposals, etc. **98,** 571.

1899. G. O. 106, War Department, A. G. O. Washington, July 23, 1898, changed the name of the fort at Willets Point, N. Y., to Ft. Totten, in honor of Brig. Gen. Joseph G. Totten, Chief of Engineers, who died Apr. 22, 1864. **99,** 651. Discussions on the Army canteen. **99,** 652. Stations of the various companies given. **99,** 652. By act of Mar. 2, 1899, the enlisted strength of the battalion of Engineers was established as 752, its previous legal strength, and the battalion of Engineers, and the officers serving therewith, to constitute a part of the line of the Army. **99,** 657. Extracts from reports as to the service rendered by the battalion of Engineers. **99,** 658. List of submarine mine materials, etc., and equipment of Engineer troops. **99,** 664. $150,000 app. May 4 and July 7, 1898, for procurement of pontoon trains, intrenching tools, instruments, drawing materials, etc., and $60,000 app. July 7, 1898, for employment of civilian assistants to Engineer officers in the field. Engineering supplies purchased for Engineer officers of 7 Army corps and for 3 regiments of Volunteer Engineers in equipping them for duty in the field in Cuba, Porto Rico, and the Philippine and Hawaiian Islands. **99,** 8.

1900. $50,000 app. Mar. 3, 1899, and $25,000 app. for the fiscal year 1901, for equipment of Engineer troops and civilian assistants to Engineer officers. **00,** 35. Stations of the different companies of the battalion of Engineers given. **00,** 1051. Discussion on the legislation contemplating the transfer of submarine mining defenses to the Artillery arm of the service. **00,** 1046.

1900–01. $7,202.45 allotted for repair of buildings, roads, and walks; $34,258 for new Artillery barracks; $6,909 for new ordnance storehouses; and $775 for a boathouse; new buildings completed and occupied. Est. $163,000 for quarters. Est. $114,000 for enlarging post. **01,** 38, 927. Defective arrangement of barracks. **01,** 928. Reclamation of adjacent marshes would go far to remove source of malarial troubles. 01, 931.

MISCELLANEOUS REPORTS.

Temporary detachments during the year. 80, 297; 81, 419.

Engineer recruiting and desertions and discipline. 80, 298; 81, 420; 82, 445; 83, 390; 84, 426; 85, 428; 86, 491; 87, 421; 88, 350; 89, 473; 90, 394; 91, 541; 92, 475; 93, 650; 94, 470; 95, 524; 96, 463; 97, 573.

Stations of the battalion at the end of the year. 80, 299; 81, 421.

Drills and instruction. 80, 300; 90, 397; 91, 544; 92, 477; 93, 653; 94, 473; 95, 525; 96, 462; 97, 563, 571.

Course of instruction and drills given for future work. 80, 302; 81, 429; 82, 472; 83, 395; 84, 449; 85, 495; 86, 474; 87, 425.

Military duties of the battalion. 80, 299; 81, 422; 82, 445; 83, 391; 84, 426; 85, 429; 86, 491.

Results of astronomical observations. 80, 307; (maps) 81, 433; 82, 458; 85, 436.

Results of meteorological observations. 80, 312; 81, 449; 84, 448; 85, 454.

The standing of the noncommissioned officers of the several companies of the battalion as determined by their recitations to their company officers during the winter season. 80, 313; 81, 448; 82, 475; 84, 453; 85, 455.

Results of target practice (maps). 80, 314; 81, 425; 82, 448; 84, 430; 85, 446. Modification of the system of target practice. 80, 318.

Engineer School of Application. 81, 422; 82, 446; 83, 392; 84, 427; 85, 429; 86, 474; 87, 415, 433; 88, 347; 89, 471; 90, 392; 91, 539; 92, 474; 93, 649; 94, 468; 95, 523; 96, 453; 97, 562; 98, 565; 99, 653; 00, 1047.

Operations of the photographic laboratory. 80, 302; 81, 425; 82, 448; 83, 394; 84, 429; 85, 432; 88, 370; 90, 401.

Organization of the Engineer School of Application. 86, 474.

Course of winter instruction. 86, 477; 87, 425; 88, 357; 89, 484; 90, 409; 91, 553; 92, 484; 93, 662; 94, 481; 95, 532; 96, 457; 97, 566.

Course of summer instruction. 86, 481; 87, 428; 88, 360; 89, 487; 90, 407, 411; 91, 556; 92, 487; 93, 660; 94, 485; 95, 530; 96, 460; 97, 568.

Assignment to charge of departments of instruction. 86, 483; 87, 430; 88, 363.

Water supply, sewers, and hospital accommodations. 86, 484.

Plan and ests. for brick barrack. 86, 486.

Experiments and results. 87, 417 (photographs); 88, 351 (photographs); 89, 478; 90, 401; 91, 551, 559; 92, 481, 490; 93, 656; 94, 477 (photographs); 95, 529.

Public buildings and construction. 87, 422; 88, 355; 89, 476; 90, 398; 91, 547; 92, 479; 93, 648, 654; 94, 468, 474; 95, 527; 97, 574; 00, 1052.

Depot property. 87, 423; 88, 355; 89, 478; 90, 399; 91, 548; 92, 480; 93, 655; 94, 475; 95, 527.

Quartermaster and Subsistence Department. 95, 522.

Marching, camping, and parades. 97, 571; 00, 1047.

Torpedoes, list of material, etc. 97, 577; 98, 572; 99, 675; 00, 1056.

Instruments, depot. 75, ii, 1109; 76, iii, 563; 78, iii, 1667; 97, 576; 99, 674; 00, 1054, 1061.

Work of the different departments. 99, 656; 00, 1047.

Statement of funds given in each report.

MISC. 33. POSTS—JEFFERSON BARRACKS, MO.

ENGINEERS.

Chief of Engineers. R., 66, ii, 19; 67, 15; 68, 22; 69, 21; 70, 29; 71, 28; 72, 28; 73, 29.

In charge:

Capt. W. Ludlow, 1867–68.
Capt. P. C. Hains, 1868–71.

OPERATIONS.

1868. The post of Jefferson Barracks (about 300 acres of land) transferred to the Corps of Engineers by G. O. No. 9, dated Oct. 21, 1867, Headquarters Military Division of the Missouri. $20,000 paid to the Quartermaster's Department for the property. Alterations to barracks and repairs to buildings. 68, 22.

1869–70. Work on quarters in progress. 69, 21; 70, 29.

1871. Company E reduced and reorganized; left for West Point Mar. 1, 1871. Engineer property left under the care of a small detachment of Engineer soldiers. Post, with all lands appertaining thereto, transferred to the Ordnance Department. 71, 28.

1873. Engineer material stored at the post disposed of by auction in June, and the detachment left to guard it was ordered to Willets Point. 73, 29.

MISC. 34. POSTS—WASHINGTON BARRACKS.

In charge:

Maj. W. M. Black. **02,** 793; **03,** 683.
Maj. Edw. Burr. **03,** 683.

1901–02. Reservation located at southern extremity of city of Washington, D. C., lying between Washington chan. of the Potomac R. and the James Creek Canal. Contracts made for filling in low lands and protecting them by sea wall. Post of Ft. Foote, Md., placed under charge of the post commander Nov. 26, 1901, and is used by the Engineer battalion for enginnering instruction and target practice. **01,** 39, 793.

1902–03. Plans preparing for reconstruction of post building and constr. of War College Building commenced. Target facilities most unsatisfactory. Necessity for a Government rifle range. **03,** 17, 683.

MISC. 35. POSTS—YERBA BUENA ISLAND, CAL.

ENGINEERS.

Chief of Engineers. R., 68, 22; **69,** 21; **70,** 30; **71,** 28; **72,** 28.
In charge: Capt. S. M. Mansfield, 1868–71.

OPERATIONS.

1868. This post and depot were constituted by S. O. 34, dated A. G. O., Feb. 10, 1868, and was first occupied on Mar. 25. Work begun on making roads, clearing, and preparing part of the land for permanent occupation, and improving the supply of water. **68,** 22.

1869. Wharf built and necessary barracks, guardhouse, hospital, and other buildings completed. **69,** 21

1870. A military survey of the island in progress. **70,** 30.

1871. By G. O. 122, series of 1870, from the War Department, Company D, stationed at this post, was reduced and the skeleton company ordered temporarily to Willets Point. The Engineer property was left in charge of a small detachment left for that purpose. On June 30, 1871, this post was transferred, by orders of the Sec. of War, to the Quartermaster's Department. **71,** 28.

1872. Engineer property was destroyed by fire on May 3, 1871. The small detachment of Company D, left to guard it, was ordered to Willets Point. **72,** 28.

MISC. 36. SCHOOLS—ENGINEER SCHOOL OF APPLICATION, U. S. A.

In charge:

Maj. Wm. M. Black.

1901–02. Name changed from "U. S. Engineer School" to above title. Method of instruction by lectures, course of reading, students taking notes, preparation of theses and projects on subjects selected by the instructors. Trade school established for training enlisted in the various mechanical trades. **02,** 40, 796.

1902–03. Route work done. Imp. of bridge equipage and preparation of Engineer Field Manual considered. **03,** 19, 689.

1903–04. Instruction of officers suspended. Instruction of enlisted men and other duties continued; equipment of school continued. **04,** 12, 13, 751.

MISC. 37. SCHOOLS—U. S. ENGINEER SCHOOL, FORT TOTTEN.

(See Misc. 31–36 above.)

In charge:

Maj. John G. D. Knight, 1901.
Maj. Wm. M. Black, 1901.

1900–01. School work interrupted by necessity for organizing and training additional companies of Engineer troops. Work of compiling field manual begun. **01,** 39, 937.

MISC. 38. TROOPS, ENGINEER (1901-1912).

(See also Misc. 2-42 on p. 2039-2053 of this index.)

1900-01. Companies C and D at garrison; Companies A, B, and E duty in Philippines; portion of Companies A and B accompanied Pekin relief expedition. Battalion reorganized into 3 battalions., an. act Feb. 2, 1901. Est. $10,000 for plant for railroad instruction. **01, 39, 943.**

1907-08. Work of troops greatly increased. Under date Sept. 25, 1907, War Department authorized recruiting existing battalions to their full war strength.

Schedule of proposed increase in the commissioned personnel of the Corps of Engineers, U. S. Army.

Increase on account of—	Grades.								
	Brig. gen.	Col.	Lt. col.	Maj.	Chaplain.	Capt.	1st lt.	2d lt.	Total.
Additional officers for military and civil works of construction		4	7	13		18	18		60
Officers for additional 3 battalions				3		12	30	12	57
Officers for regimental organization		3	3			9			15
Total increase		7	10	16		39	48	12	132
Present authorized strength	1	10	16	32	1	43	43	43	189
Total strength with proposed increase	1	17	26	48	1	82	91	55	321
Proportion of each grade to total number:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	
Now		5.3	8.0	16.9	0.5	21.8	22.8	22.8	
With proposed increase		5.3	8.0	15.0	0.3	25.5	28.3	17.1	

08, 6, 7.

Engineer troops. **1908-10.** Difficult to raise companies to full strength. **09, 7, 8; 10, 9.**

Act Feb. 27, 1911, provides for increase. **11, 5; 12, 5.**

Battalions of Engineers, First, Second, and Third.

Chief of Engineers. R., 01, 945, 979; 02, 40, 607, 802; 03, 5, 7, 19, 686.

NOTE.—See above references for list of officers of Companies A-E, and p. 2053 of this index.

Under the requirements of section 11 of the act of Congress approved Feb. 2, 1901, fixing the enlisted force of the Corps of Engineers at 1 band and 3 battalions of 4 companies each, G. O. No. 22, Headquarters of the Army, Adjutant General's Office, Feb. 26, 1901, prescribed the following organization:

The First Battalion, to consist of Companies A, B, C, and D, at Manila, P. I.

The band and the Second Battalion, to consist of Companies E, F, G, and H, at Ft. Totten, Willets Point, N. Y.

The Third Battalion, to consist of Companies I, K, L, and M, at Ft. Totten, Willets Point, N. Y., except Company M, which was ordered to be formed at West Point, N. Y., from the detachment there. The remaining companies of this battalion were not to be formed until the organization of the Second Battalion was effected.

The designation of the existing Companies E, C, and D, of the Battalion of Engineers, was changed as follows:

Company E to Company C.
Company C to Company E.
Company D to Company F. **01, 944.**

MISC. 39. TROOPS, ENGINEER — EQUIPMENT OF ENGINEER TROOPS AND CIVILIAN ASSISTANTS TO ENGINEER OFFICERS (1900-1904).

(See Misc. 40 on p. 2059 of this index.)

APPROPRIATIONS.

	Troops.	Civilian assistants.	
1900	25,000	25,000	00, 35 01, 37
1901	20,000	25,000	01, 37
1902	25,000	25,000	02, 38
1903	25,000	25,000	03, 23
1904	25,000	25,000	04, 17

Equipment of Engineer Troops and Civilian Assistants to Engineer Officers.

1900–01. Provisions made for equipment of Engineer troops in the field, procurement of pontoon trains, intrenching tools, instruments, drawing materials, etc., and for civilian assistants to Engineer officers serving on the staffs of division, corps, and department commanders, to enable them to secure the employment of surveyors, draftsmen, photographers, and clerks. Supplies furnished for various military departments in the U. S., the Philippines, and Porto Rico, and the several Engineer officers of important military commands and departments. **01,** 37; **02,** 38; **03,** 23, 697; **04,** 17, 766. (After 1904 equipment of troops reported on independent of civilian assistants.)

MISC. 40. TROOPS, ENGINEER — ENGINEER EQUIPMENT OF TROOPS (1905-1912).

(See Troops, Engineer, 1900–1904, above.)

APPROPRIATIONS.

1905,	$15,000, **05,** 18.
1906,	40,000, **06,** 15.
1907,	40,000, **07,** 18.
1908,	72,500, **08,** 24.
1909,	90,000, **09,** 26.
1910,	90,000, **10,** 30.
1911,	90,000, **12,** 26.
1912,	90,000, **12,** 26.
Total,	527,500

1904–05. Unfit condition of pontoon bridge equipment. Should be thoroughly overhauled and parts rebuilt. Purchase and issue o. reconnoissance instruments prescribed by G. O. No. 24, War Department. To entirely fit out all organizations will require $15,000. **05,** 19, 764.

1905–06. Importance of searchlights in both siege and field operations. Proposed to apply $15,000 to investigation and to purchase of outfit for experimental tests. **06,** 15.

1906–07. Demand for Engineer Field Manual. Decided to prepare a new edition. Numerous repairs to material, purchase of 3 battery and forge wagons, steel pontoon boat, 60 waterproo floats, 2 canvas pontoon covers. **07,** 18, 869.

1907–08. 37 chess wagons delivered and distributed, numerous repairs to material on hand, purchase of 1 steel pontoon boat and 1 pontoon tool wagon. **08,** 24, 911.

1908–09. Considerable additions made to equipment. **09,** 26, 959.

1909–12. Engineer equipment distributed to various military divisions and departments in the U. S. and insular possessions. **10,** 30, 1070; **11,** 28; **12,** 25.

MISC. 41. ENGINEERS, CORPS OF — CIVILIAN ASSISTANTS TO ENGINEER OFFICERS.

(See Misc. 39 on p. 2059 of this index.)

APPROPRIATIONS.

1905,	$25,000,	**05**, 19.
1906,	25,000,	**06**, 17.
1907,	25,000,	**07**, 19.
1908,	25,000,	**08**, 24.
1909,	40,000,	**09**, 27.
1910,	40,000,	**10**, 31.
1911,	42,000,	**12**, 27.
1912,	40,000,	**12**, 27.
Total,	262,000	

1904–07. Est. $25,000 submitted. **05**, 19; **06**, 16; **07**, 19.

1907–08. Increase in map work, Philippines Division, necessitated a large allotment to that division. Est. $40,000 submitted. **08**, 25; **09**, 27.

1909–10. Est. $42,000 submitted. **10**, 31.

1910–11. Est. $40,000 submitted. **11**, 29; **12**, 27.

MISC. 42. TROOPS, ENGINEER — NONCOMMISSIONED OFFICERS OF ENGINEERS.

Chief of Engineers. **08**, 8; **09**, 8; **10**, 9; **11**, 5; **12**, 5.

1907–08. Recommendation establishing one grade of "Sergeant," first class; two, grades of "Military overseer"; three, each battalion increased by battalion train sergeant and battalion commissary sergeant. **08**, 9.

1908–09. Grade of "private, second class," should be changed to "private." There should be added to each battalion of engineers 1 color sergeant, 1 commissary sergeant, 1 train sergeant, and 1 trumpeter-corporal, and to each company 10 sergeants, first class, 2 mechanics, 2 wagoners, 2 farriers, 1 blacksmith, and 1 saddler. Number of sergeants in each company should be increased to 22, corporals to 26, cooks to 4; "privates, first class," reduced to 36, "private" to 54. **09**, 8; **10**, 9; **11**, 5; **12**, 5.

MISC. 43. D. C.—BRIDGES—AQUEDUCT BRIDGE.

NOTE.—The piers of this bridge, originally constructed to carry a canal across the Potomac at Washington, D. C., were built between 1835 and 1840, of Potomac R. gneiss, laid in the form of rough rubble masonry, except the ice breakers, which are of cut granite.

In 1868 a floor system and approaches were added and the structure was used as a highway toll bridge until 1886, when the Government purchased it and erected the present superstr. on the old piers.

Shortly after the freshet of June, 1889, pier No. 1 (the first from the Virginia end) was observed to have moved several inches, and defects in other piers were noticed. An ex. and the first repairs of which there is any record were made at that time under the direction of the Commissioners of the District of Columbia, to whose custody the bridge had been transferred.

Examinations by diver and such minor repairs as were found necessary have been made from time to time since under the direction of the Sec. of War.

These exs. have shown that there is in process a gradual deterioration of the masonry of the piers below the water line. The defects show usually in the form of cavities caused by the dropping out, during freshets, of one or more of the sts. in or near the face.

These cavities have usually been repaired by filling them with concrete in bags, deposited by a diver. In some instances the repaired portions have been protected by placing riprap in front of them. In 3 of the piers, Nos. 1, 4, and 5, the defects became so serious that this method of repair was impracticable, and new piers have been built to replace the old ones.

The first repairs made under the direction of the War Department were provided for by an act of Congress of Aug. 7, 1894, which app. $51,070 for this purpose.

Piers 2, 3, 5, 6, 7, and 8 were repaired by the use of concrete in bags, placed by a diver, and repairs to pier 4 by the use of a cofferdam were commenced. The total expend. was $46,379.70. The balance of $4,690.30, being insufficient to complete the work at pier 4, reverted to the Treasury.

Piers 4, 5, and 1 were subsequently entirely rebuilt under separate apps. of $65,000, $65,000, and $80,000, respectively.

Congress, by joint resolution approved July 1, 1902, enacted as follows:

"That the Secretary of War be, and he is hereby, authorized to spend an amount not exceeding three thousand dollars from the balance of appropriations for the reconstruction of pier numbered four of the Aqueduct Bridge, District of Columbia, for the purpose of the examination of and immediate temporary repairs to the remaining piers of said bridge in cases of need arising from flood or ice."

The act of Congress approved Mar. 2, 1907, making apps. for the expenses of the government of the District of Columbia for the fiscal year ending June 30, 1908, contains the following item:

"And the unexpended balance, amounting to about fourteen thousand dollars, of the appropriations for the reconstruction of piers numbered four and five of said bridge is hereby reappropriated and made available for the periodical examination of the remaining piers of the bridge and making of such repairs as may be found necessary."

The last ex. of the old piers by diver was made during October, 1911, and such defects as were found were repaired in the usual manner, by the use of concrete in bags and the piers left in as good condition as practicable; only a question of time when all of the old piers will have reached a stage when this method will be impracticable, even for temporary repairs.

Tentative plans and ests. have been prepared for a more radical scheme of repair, and soundings and probings have been made to determine the amount of work required.

Ests. for 3 plans for remedying existing conditions submitted in annual report for fiscal year 1910:

A. For complete removal of the present bridge and replacing it with a new one, including new superstr., $950,000.

B. For complete removal of the remaining 5 old piers and replacing them with new ones and repairing the abutments, using the present superstrs., $350,000.

C. For thoroughly and permanently repairing the remaining 5 old piers and 2 abutments, using the present superstr., $150,000.

A possible objection to project C above is that the repairs under this project might detract from the appearance of the bridge. Suggested that the proper committee of Congress might direct the Commission of Fine Arts, established by act of the second session, Sixty-first Congress, to render an opinion. **12,** 1310, **1311.**

APPROPRIATIONS.

1895,	$51,070,	**95,** 4099.
1896,	65,000,	**96,** 3886.
1902,	65,000,	**03,** 2483.
1907,	80,000,	**07,** 832.
Total,	261,070	

CONTRACTS.

1903. Penn Bridge Co., reconstr. Pier No. 5, $54,956. **03,** 2484.

1907. Chas. McDermott; reconstr. Pier No. 1, prices listed. **08,** 2347.

ENGINEERS.

Chief of Engineers. **R., 95,** 484; **96,** 429; **97,** 536; **98,** 539; **99,** 626; **00,** 703; **01,** 669; **02,** 591; **03,** 652; **04,** 723; **05,** 731; **06,** 810; **07,** 830; **08,** 875; **09,** 921; **10,** 1033; **11,** 1092; **12,** 1310.

In charge:

Maj. C. E. L. B. Davis. **R., 95,** 4085.

Lt. Col. C. J. Allen. **R., 96,** 3883; **97,** 3987; **98,** 3571; **99,** 3777; **00,** 5123; **01,** 3637; **02,** 2651; **03,** 2483.

Col. A. M. Miller. **R., 04,** 3877.

Lt. Col. S. S. Leach. **R., 05,** 2603.

Capt. Spencer Cosby. **R., 06,** 2079; **07,** 2271; **08,** 2345.

Maj. J. J. Morrow. **R., 09,** 2301.

Capt. W. T. Hannum. **R., 10,** 2623.

Lt. Col. W. C. Langfitt. **R., 11** 2933; **12,** 3455.

Assistant. J. Meigs, jr. **R., 01,** 3641.

OPERATIONS.

1900–01. Old masonry of Pier No. 4 removed; new pier practically completed. Other piers examined; several in bad condition. Cavities filled with concrete, and protected with riprap. **01,** 669, 3637.

1901–02. Remaining work completed. **02,** 591, 2652.

1903–04. On Pier No. 5 work started; cofferdam completed; cavities of remaining piers repaired. **04,** 723, 3877.

1904–05. Work on Pier No. 5 completed. **05,** 731, 2603.

1906–07. Piers 2, 3, 6, 7, and 8 repaired. Plans prepared for reconstr. Pier No. 1. **07,** 2271.

1907–08. Masonry work on Pier No. 1 completed; portions above water of other piers pointed. **08,** 875, 2345.

1908–09. Repairs to cavities in old piers; reconstr. Pier No. 1 completed. **09,** 921, 2301; **10,** 1033, 2623; **12,** 1310, 3455.

MISC. 44. D. C.—BRIDGES—PRESERVATION AND REPAIR OF CABIN JOHN BRIDGE.

For many years considerable leakage has occurred in the section of the conduit which passes through Cabin John Bridge.

In 1863, when the water-supply system of the District of Columbia was first put in service, the water was not allowed to rise high enough to fill the conduit completely. With the increased consumption of water, however, the elevation of its surface has been raised, until in recent years even the crown of the conduit has been under pressure, due to a head of about 2 feet.

When first used, leakage was observed and the water was drawn off and the lower part of the conduit was plastered. In a "recent" attempt to stop the leaks the upper portion of the conduit was plastered. While this doubtless reduced the leakage, there was still a very noticeable flow through the joints of the lining and the masonry in cold weather. This caused disintegration of some of the masonry and an unsightly appearance as well as a considerable waste of water.

Several cracks developed in the lining of the conduit. These were kept filled with mortar, but continued to open until this feature became so serious that an app. was requested in a report published as Doc. 1329, H. R., 61st Congress, 3d session, for placing a metal lining in the conduit.

An app. of $35,000 for the preservation and repair of the bridge was contained in the District of Columbia app. act approv. Mar. 2, 1911, $20,000 of which was made immediately available.

This work, completed in 1912, consisted of a cast-iron lining through the bridge, steel tie rods across both ends, a new roadway, and a reset coping.

The lining is composed of 501 linear feet of cast-iron plates three-fourths inch thick, cast in the form of arcs of an 8′ circle 3′ wide. Six of these plates form a circle and are bolted to one another longitudinally and circumferentially through flanges cast on the plates. This form of lining is typical of many tunnel linings, both in this country and abroad, and is the same as was used in the Washington Aqueduct tunnel under Rock Creek.

Between the cast-iron lining and the old brick ring the space was filled with Portland cement grout poured in through holes cut in the bridge paving. On the inside of the ring, where the flanges project 3 inches from the plates, the space was filled with concrete to form a perfectly smooth waterway. Some of this concrete was placed by hand, with forming, and some was placed by use of the cement gun.

Directly beneath this lining at each end of the bridge 6 tie rods of 1½″ steel, with turnbuckles, were placed transversely through the bridge to prevent further spreading.

The old brick roadway over the bridge was replaced with one of asphalt blocks by contract for $2,012.40, and in order to make this surface impervious to water it was treated with Tarvia A and screenings in the usual manner. The coping, which was badly out of alignment, was taken up and reset.

Since the installation of the lining the bridge passed through a very severe winter without leakage. **12,** 3463, 3464.

ENGINEERS.

Chief of Engineers **R., 11,** 1096; **12,** 1313.

In charge. Lt. Col. W. C. Langfitt. **11,** 2935, 2942; **12,** 3463.

Assistants.

Capt. W. T. Hannum, 1911-12.
1st Lt. J. S. Bain, 1912.

MISC. 45. D. C.—HIGHWAY BRIDGE OVER POTOMAC RIVER.

APPROPRIATIONS.

1901, $568,000, **01,** 119.
1904, 428,000, **04,** 3880.
1905, 200,000, **05,** 734.

Total, 1,196,000

CONTRACTS.

1903. Pennsylvania Steel Co., for constr bridge, unit prices listed. **04,** 3881.

1904. The Cranford Paving Co., depositing material, 25¢ c. y.; Chas. G. Smith & Son, riprap st., 3,000 c. y., $1.53 c. y. **05,** 2607. Cranford Paving Co., constr. macadam roadway, unit prices listed; Martin McNamara, constr. terra-cotta pipe sewers, unit prices listed; Penn Bridge Co., constr. concrete-steel arch bridge, prices listed; Potomac Electric Power Co., furnishing, installing, maintaining arc lights on bridge, 6¢ kilowatt hour, $85 per lamp per year for arc lights. **06,** 2085.

1905. Ernest L. Miner, constr. earth embankment approach to highway bridge, 700,000 c. y. earth, 64¢ c. y.

1906. Rudolph S. Blome Co., constr. of paving, etc., on approaches to highway bridge, prices given. **07,** 2281.

1907. Sand, Gravel & Supply Co., constr. of macadam roadway on Virginia approach, prices listed; American Street Lighting Co., lighting bridge, $20.85 per burner. **07**, 2281; **08**, 2351.

ENGINEERS.

Chief of Engineers. **01**, 119; **02**, 592; **03**, 653; **04**, 724; **05**, 734; **06**, 811; **07**, 832; **08**, 876; **09**, 923.

In charge:

Lt. Col. C. J. Allen. **R.**, **02**, 2651; **03**, 2484.
Col. A. M. Miller. **R.**, **04**, 3879.
Lt. Col. S. S. Leach. **R.**, **05**, 2605.
Capt. Spencer Cosby. **R.**, **06**, 2080; (**Maj.**) **07**, 2273; **08**, 2347; **09**, 2303.

Board of Engineers.

Au. Sec. of War; constituted to select site to formulate plans, specifications, and ests. for bridge. Submitted **R.** Oct. 25, 1901.

OPERATIONS.

1902–03. Preparatory work. **03**, 2484.

1903–04. Constr. work commenced; considerable progress made in excavation, pile driving, and cofferdam constr. Work on steel for superstr. started in mills and shops. **04**, 725, 3879.

1904–05. Substr. and superstr. practically completed; embankment for Washington approach now completed; work started on Virginia approach. **05**, 733, 2605.

1905–06. Bridge opened to traffic Feb. 12; on Washington approach work done toward installation of drainage and electric-light systems, etc. Work started on a reinforced concrete arch bridge across Washington Chan. **06**, 813, 2080.

1906–07. All Government work in connection with constr. of highway bridge practically completed, except minor details, as placing lamps, finishing macadam road, etc. **07**, 835, 2273.

1907–08. Macadam roadway on Virginia approach completed; small tool house erected; erection of lamp-posts, etc.; other misc. work. **08**, 2348. A standard underground electric railway system installed by the Washington, Alexandria & Mount Vernon Ry. Co. from foot of 14th Street to plow pits. From plow pits to north end of bridge an overhead trolley system with ground return, is in use and legislation au. the permanent retention of this system is pending before Congress. **08**, 877.

1908–09. Transferred to Public Buildings and Grounds. **09**, 2303.

PROJECTS.

Act Feb. 12, 1901, au. Sec. of War to contract with Baltimore & Potomac R. R. Co. or others to build within 2 years at point not less than 500′ above site of "present" long bridge a new switch drawbridge for highway travel. **01**, 119.

Board submits 2 designs—No. 1, $575,000; No. 2, $996,000. Favors No. 2. Plans given in detail (H. D. No. 138, 57th Cong., 1st sess.). **02**, 2652.

MISC. 46. D. C.—BRIDGES—HIGHWAY BRIDGE OVER POTOMAC RIVER—MAINTENANCE AND OPERATION.

APPROPRIATIONS.

Mar. 3, 1905,	$7,000.
June 27, 1906,	11,600, **06**, 814
Mar. 2, 1907,	16,000, **08**, 2351.
May 26, 1908,	16,000, **08**, 2351.
Mar. 3, 1909,	16,000, **09**, 2303.
Total,	66,600

ENGINEERS.

Chief of Engineers. **R.**, **06**, 818; **07**, 835; **08**, 877.

In charge. Capt. Spencer Cosby. **R.**, **06**, 2082; **07**, 2277; **08**, 2349.

OPERATIONS.

1905–07. Repairs of minor nature; tools and supplies purchased; lockers and shelters constr.; riprap placed along foot of slopes. **06**, 2083; **07**, 2277.

1907–09. Repairs to various parts of the operating machinery; steelwork repainted, etc. **08**, 2350; **09**, 2303.

1908–09. Repairs made to fender system of highway bridge and portions of ironwork painted. **09**, 930, 2355; **11**, 2986; **12**, 3507.

MISC. 47. D. C. — BRIDGES — MEMORIAL BRIDGE ACROSS POTOMAC RIVER.

APPROPRIATION.

1899, $5,000.

Chief of Engineers. **R., 98,** 540; **99,** 42, 627; **00,** 43, 704; **01,** 670; **02,** 591; **03,** 653.

Board of Engineers. BE. and of architects upon certain designs for a memorial bridge across Potomac R. from Washington, D. C., to Arlington, Va., ordered by act of Feb. 5, 1900. **R., 00,** 5126. (Lt. Col. C. J. Allen, Maj. T. W. Symons, Capt. D. D. Gaillard, and Stanford White and Jas. G. Hill.)

In charge. Lt. Col. C. J. Allen. **R., 98,** 3573; **99,** 3777; **00,** 5125; **01,** 3648; **02,** 2652; **03,** 2484.

Designers and architects: W. H. Barr, W. R. Hutton, L. L. Burk, and G. S. Morison. **R., 00,** 5146.

OPERATIONS.

Nothing ever done toward the constr. of this bridge.

MISC. 48. D. C.—BRIDGES—BRIDGE ACROSS POTOMAC AT FOOT OF SOUTH CAPITOL STREET.

ENGINEERS.

Chief of Engineers. **R., 96,** 430.

In charge. Maj. C. E. L. B. Davis. **R., 96,** 3890.

SURVEYS.

Survey plan and est. called for, through Sec. of War, by act Mar. 2, 1895, for a bridge from the foot of South Capitol St., or below it, across Eastern Branch of the Potomac, with recom. Made by Maj. Davis. Most suitable location found to be at the foot of First St. SW.; est., $779,130; but "no such bridge should ever be permitted to be built." H. D. 163, 54th, 1st.

MISC. 49. D. C.—BRIDGES—ACROSS EASTERN BRANCH OF THE POTOMAC, IN LINE OF MASSACHUSETTS AVENUE EXTENDED.

ENGINEERS.

Chief of Engineers. **R., 98,** 541.

In charge. Lt. Col. C. J. Allen. **R., 98,** 3598.

SURVEYS.

R. required by act Feb. 17, 1897, submitted Nov. 29, 1897. By Col. Allen. Steel truss bridge on masonry piers proposed; decked, except where it crosses the Baltimore & Potomac R. R. Plans submitted for fixed spans and total length of 2,517′ and width of 52′; est., $441,208. Est., including draw, $476,843; necessity of draw not apparent. H. D. 140, 55th, 2d.

MISC. 50. D. C.—BRIDGES—ROCK CREEK BRIDGE IN LINE OF MASSACHUSETTS AVENUE EXTENDED.

APPROPRIATION.

Mar. 3, 1897, $2,000, **98,** 541.

ENGINEERS.

Chief of Engineers. **R., 98,** 541.

In charge. Capt. D. D. Gaillard. **R., 98,** 3606.

SURVEYS.

Act Mar. 3, 1897, au. Chief of Engineers to report plans and cost of erecting st. arch bridge, also steel bridge with st. foundations, over Rock Creek, on line of Massachusetts Ave. extended. Col. (Vols.) Gaillard submitted designs and est. st. bridge, $568,545; steel bridge, $199,204. St. bridge deemed better. H. D. 163, 55th, 2d.

MISC. 51. D. C.—BUILDINGS—EXTENSION OF BUILDINGS BEYOND THE BUILDING LINES IN THE CITY OF WASHINGTON (1900-1912).

1900-01. Act of Congress approved Mar. 3, 1891, provides that no permits shall thereafter be granted for the extension of buildings beyond the building line except with the concurrent approval of the Sec. of War.

436 applications referred to War Department and reported on. **01,** 3725.

1901-02. 515 applications referred to War Department. **02,** 2745.

1902-03. 486 applications referred to War Department. **03,** 2570.

1903-05. 515 applications referred to War Department. **04,** 3957; **05,** 2661.

Approval of Sec. of War only on applications for protection to buildings on private lots adjoining public reservations, act June 21, 1906. **06,** 2150; **07,** 2343; **08,** 2416; **09,** 2367; **10,** 2682; **11,** 2995; **12,** 3518.

MISC. 52. D. C.—BUILDINGS—ENGINEER SCHOOL.

APPROPRIATIONS.

June 30, 1902,	$500,000	**03,** 2935.
Mar. 2, 1903,	360,000	
Mar. 2, 1905,	150,000,	**05,** 2826.
Mar. 2, 1907,	32,500,	**07,** 2474.
July 25, 1912,	100,000,	**12,** 29.
Total,	1,142,500	

CONTRACTS.

List of. **03,** 2936; **04,** 4196; **05,** 2831.

ENGINEERS.

Chief of Engineers. R., 03, 675; **04,** 740; **05,** 748; **06,** 829; **07,** 860; **08,** 900; **09,** 946; **10,** 1057; **11,** 31; **12,** 28.

In charge. Capt. J. S. Sewell. **R., 03,** 2931; **04,** 4183; **05,** 2826; **06,** 2259; **07,** 2474; **08,** 2555.

OPERATIONS.

1902-03. Work begun; excavation well advanced on 2 mess-hall and kitchen buildings; foundations for band, barracks, also officers' quarters under way, etc. **03,** 675, 2934.

1903-04. Work well advanced on the quartermaster and commissary storehouse, and on foundations of engineer storehouse and bachelors' quarters for officers. **04,** 741, 4191.

1904-05. Following buildings completed and occupied: 13 sets of officers' quarters, the officers' mess, 1 barrack building for 2 companies, 1 band barrack, 2 mess-hall buildings, 1 quartermaster and commissary storehouse, 1 new stable, and 1 new wagon shed. **05,** 748, 2825.

1905-06. Various buildings completed in addition to above. **06,** 829, 2259; **07,** 2474; **08,** 2555; **09,** 946; **10,** 1057.

Allotment $100,000 for constr. at Engineer School of building with library accommodations and other facilities. **12,** 28.

MISC. 53. D. C. — GOVERNMENT PRINTING OFFICE ERECTION.

APPROPRIATIONS.

Mar. 3, 1899,	$350,000	**01,** 686.[1]
June 6, 1900,	775,000	
Mar. 3, 1901,	1,304,000	
Total,	2,429,000	

CONTRACTS.

List. **01,** 3821; **02,** 3068; **03,** 2924; **04,** 3861.

ENGINEERS.

Chief of Engineers: 01, 687; **02,** 611; **03,** 673; **04,** 739; **05,** 747.

In charge. Capt. J. S. Sewell. **R., 01,** 3801; **02,** 3065; **03,** 2919; **04,** 3819, 4179; **05,** 2823.

OPERATIONS.

1900-01. Act Mar. 3, 1899, au. constr. of a fireproof building for use of Government Printing Office, cost not to exceed $2,000,000; increased by resolution Congress, Feb. 17, 1900, to $2,429,000. Mr. J. G. Hill appointed architect.

Actual work commenced; old buildings removed from site. At close of year foundations, steelwork, and underground drains practically completed walls built to second floor; power-house extension under roof; 80% of plans and drawings completed. **01,** 686, 3801, 3822.

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[1] $19,163.33 deposited in U. S. Treas.

1901–02. Steelwork entirely finished; fireproofing entirely completed; exterior walls finished; interior partitions about 80% finished; nearly all door and window frames in place; roof weather tight and half finished; beginning made on plastering and leveling up floor arches, etc. **02,** 611, 3065.

1902–03. Building practically completed; details of work done. **03,** 673, 2921.

1903–04. Entirely completed and turned over to the Public Printer. **04,** 739, 3819, 4179.

Technical details. **04,** 3819.

MAPS, PLANS, SKETCHES, ETC.

Plans, architect's pen sketch of proposed building; typical floor plan, elevation on North Capitol St.; elevation on G St. **01,** 3822; **04,** 3860.

Photographs, excavation, concreting o piers, underpinning at laundry, column covering, flange covering, girder covering, general view from southeast corner, under view of fireproofing. **01,** 3822; **04,** 3860.

Sketch, framing plan, second and upper floors; typical fireproofing details; steelwork, first floor; steelwork, 2d, 3d, 4th, 5th, 6th, and 7th floors; foundation and drainage plan. **04,** 3860.

Steelwork cross section main building; general detail of exterior and section wall; general method of piping for plumbing fixtures. **04,** 3860.

Photographs, general view of steelwork; wood-block floor in process of constr.; seventh floor, after work was practically completed; new building entirely completed. **04,** 3861.

MISC. 54. D. C. — BUILDINGS — ABRAHAM LINCOLN HOUSE, ETC. (1901-1912).

(See Misc. 65 on p. 2072 of this index.)

Inspections made from time to time in connection with their care, repair, and safety. **01,** 675, 3696; **02,** 596, 2723; **03,** 659, 2527; **04,** 3909; **05,** 2626; **06,** 2118; **07,** 2309; **09,** 2352; **10,** 2677; **11,** 2083; **12,** 1321, 3505.

Misc. repairs to Abraham Lincoln House. Work of replacing old boiler at Ford's Theater Building. **06,** 2119; **07,** 2309; **08,** 2381.

MISC. 55. D. C.—BUILDINGS—ARMY WAR COLLEGE.

APPROPRIATIONS.

June 30, 1902,	$400,000,	**03,** 2932.
Apr. 23, 1904,	300,000,	**04,** 4194.
Total,	700,000	

CONTRACTS.

Various contracts. **03,** 2933; **04,** 4195; **05,** 2829; **06,** 2269.

ENGINEERS.

Chief of Engineers. **R., 03,** 675; **04,** 740; **05,** 748; **06,** 828; **07,** 859; **08,** 899; **09,** 946; **10,** 1057; **11,** 31.

In charge:

Capt. John S. Sewell. **R., 03,** 2931; **04,** 4183; **05,** 2825; **06,** 2259; **07,** 2473.

Lt. Col. W. C. Langfitt. **R., 08,** 2555.

OPERATIONS.

1902–03. Designs completed; northeast cornerstone laid; foundations at west end practically completed; sewer completed. **03,** 674, 2931.

1903–04. Foundations finished; main walls completed; about 40% terrace work completed. **04,** 740, 4193.

Technical details giving various methods used in constr. **04,** 3866.

1904–05. Terrace of building 80% completed; building itself up to second-floor level. **05,** 748, 2827.

1905–06. Terrace of War College Building 95% completed; building itself 85% completed. **06,** 829, 2267.

1906–07. Work entirely finished, and accounts settled up. **07,** 859, 2473.

MAPS, PHOTOS., ETC.

Plan showing layout of buildings and grounds; method of reinforcing an inadequate concrete. **04,** 3869.

Photographs: View of experimental pile and point; view of experimental pile exposed on one side; view showing method of building brick wall on concrete foundation; view of concrete piles in trench. **04,** 3869. Exterior view, main entrance to War College and Engineer post grounds. **04,** 4190.

Sketch, plan showing layout of buildings and grounds. **06,** 2268.

MISC. 56. D. C. — EXECUTIVE MANSION (WHITE HOUSE).

(For details prior to 1901, see Misc. 65 on p. 2072 of this index.)

1900–01. Usual care and repairs. Old water-supply, waste, and soil pipes replaced by new ones. Private dining room repapered, redecorated, and repainted; also main corridor, and other apartments, north and south porticos repainted. Automatic fire-alarm system placed in attic; new carpets, furniture, and furnishings purchased. Plans, with est. of cost, $1,136,960, for extending mansion prepared in accordance with congressional action. Conservatory repaired and repainted; repairs to greenhouses and stable. **01,** 675, 3690, 3728.

Inventory of public property in the Executive Mansion. **01,** 3736.

Address of Col. T. A. Bingham, relative to extending Executive Mansion. **01,** 3754.

1901–02. Misc. repairs, etc. Remodeling mansion and building separate office building for the President. **02,** 596, 2720.

Inventory of public property. **02,** 2754.

Notes on the chrysanthemum by Geo. H. Brown, landscape gardener. **02,** 2761.

1902–03. Executive Mansion remodeled, redecorated, and refurnished, an addition to it built; the conservatory and greenhouses formerly attached to the mansion torn down, and five of the greenhouses reerected at the propagating gardens. Separate office building erected; extensive improvements to grounds. **03,** 658, 2519.

Inventory of public property. **03,** 2582.

1903–04. Exterior Executive Mansion and interior President's Office building painted; imp. and repairs in mansion and imp. about grounds; extensive imp. and repairs about the President's stables. Additional greenhouse built. **04,** 730.

Inventory of public property. **04,** 3970.

1904–05. Misc. repairs; 3 additional greenhouses built. **05,** 738, 2622.

Inventory of public property. **05,** 2674.

1905–06. Misc. painting, imp. in electric wiring, 2 additional greenhouses constr., and 2 new cold frames constr. **06,** 820, 2113.

Inventory of public property. **06,** 2164.

1906–07. Extensive repairs and betterments. Work commenced for repainting entire exterior; additional fire protection installed, new pavement laid, etc. **07,** 841, 2300.

Inventory of public property. **07,** 2358.

1907–08. Considerable painting; new watertight covering placed upon roof of east terrace; repairs at President's stables and to greenhouses, boilers, and heating pipes. **08,** 885, 2377.

Inventory of public property. **08,** 2430.

1908–09. Misc. repairs in and about mansion; furniture cared for; repairs to Executive Office building, President's stable, and to greenhouse structures and their heating apparatus. **09,** 929, 2332.

Inventory of public property. **09,** 2378.

1909–10. Misc. repairs; considerable painting. Additional accommodations to President's Office by erection of addition to original building; old building remodeled. **10,** 1041, 2654.

1910–11. Misc. repairs; painting; furniture regularly cared for; silver closet built; lightning rods taken down; new system of protection from lightning installed; partition built in President's Offices; other misc. work. **11,** 1103, 2961.

1911–12. Misc. repairs and painting; President's stable torn down; accommodations provided in stables of Quartermaster's Department; frame building in rear of stables moved to propagating gardens; repairs to greenhouse structures. **12,** 1319, 3483.

MISC. 57. D. C.—"FLATS"—ANACOSTIA RIVER, D. C.

The Anacostia R. rises in Prince George County, Md., and, flowing 20 m. in a southwesterly direction, joins the Potomac R. in the District of Columbia.

The portion included in this proj. extends from Anacostia Br., District of Columbia, upstream 5 m. to the District line. It is subject to a mean tidal oscillation of 3′ and a max. rise during freshet to about 12′ above m. l. w.

The chan. has not been imp. by the United States.

A report on ex. of the Anacostia R. by S. T. Abert in 1875 states that "in 1835 vessels carrying 100 hogsheads of tobacco, or about 60 tons, were able to load at Bladensburg," but no record of the exact depth at that time is available. In 1862 the min. chan. d. was 18′ at m. l. w. at Anacostia Br., 12′ at the Philadelphia, Baltimore & Washington br., and 3′ at Benning Br. In 1891 the min. chan. d. was 15′ at m. l. w. at Anacostia Br., 12′ at the Philadelphia, Baltimore & Washington R. R. br., 8′ at Benning Br., and 3′ at the District line. The "present" min. chan. ds. are about the same, except near the District line, where the min. d. is now about 2′ at m. l. w.

The channel is narrow and winding, and between the chan. and the banks are extensive flats and marshes which are alternately exposed and flooded by tidal action.

In summer the flats are covered with a rank growth of aquatic plants, which prevent a rapid cleansing movement of the tide and causes deposits of mud and filth. The meadows, which are above ordinary h. w. level, are flooded at varying intervals, whenever the water is raised by flood or easterly winds above normal level, and every depression retains a stagnant pool, a condition most favorable for the development of malaria.

The acts making app. for this work approv. Mar. 3, 1911, and June 26, 1912, have provided that the money—

"be expended under the supervision of the Chief of Engineers, United States Army, upon plans to be prepared under the direction of, and to be approved by, a board of engineers to consist of the Engineer Commissioner of the District of Columbia, the officer in charge of public buildings and grounds, and the engineer officer in charge of the improvement of the Potomac River; said sum to be available for the preparation of plans, the prosecution of the work, the employment of personal service, and for such other purposes as may in the judgment of said board be necessary to carry out the purposes of this appropriation."

Necessary surveys made; proposed to expend available funds in dr. and constr. of R. walls in the vicinity of Pennsylvania Ave. Br. and the line of Massachusetts Ave. extended.

References to examination or survey reports and maps or plans not in project documents.

Section covered.	Congressional documents.				Annual reports of Chief of Engineers.	
	House or Senate.	No.	Congress.	Session.	Year.	Page.
Bladensburg to navy yard [1]	House	94	Forty-fourth	First		
Do.[1]					1876	358
Bladensburg to mouth [2]	House	30	Fifty-second	First		
Do.[1]					1892	1064
Bridge in line with Massachusetts Avenue.[2]	House	140	Fifty-fifth	Second		
Bladensburg to mouth [2]	do	87	do	Third		
Do.[1]					1899	1443
District of Columbia line to Philadelphia, Baltimore & Washington R. R. Branch.[2]	Senate	166	Fifty-seventh	First		
Report as to title to riparian lands [2]	House	194	Fifth-ninth	do		
Do.[1]	Senate	462	Sixty-first	Second		
Do.[2]	do	19	Sixty-second	First		

[1] No maps.

[2] Contains maps.

The board of officers constituted by the act approv. Mar. 2, 1911, consisted of Lt. Col. W. C. Langfitt, Corps of Engineers, U. S. Army, in charge of the imp. of the Potomac R.; Lt. Col. W. V. Judson, Corps of Engineers, U. S. Army, Engineer Commissioner of the District of Columbia; and Col. Spencer Cosby, U. S. Army, in charge of public buildings and grounds. The board recom. a complete proj. for the work, conforming in general with the scheme of development outlined in the report of the Park Commission (R. of Senate Committee on the District of Columbia, S. No. 166, 57th, 1st) and approv. by the Commission of Fine Arts.

The general features of the proposed proj. are: (*a*) The constr. of a dam, with lock and necessary appurtenances, on the line of Massachusetts Ave., to maintain the pool above at a normal elevation of about 8′ above m. l. w. (*b*) The constr. of river walls between Anacostia Br. and the dam, with top of walls at elevation of 8′ above m. l. w. (*c*) Dr. section of R. between Anacostia Br. and the dam. (*d*) The constr. of low walls or gravel beach around the basin from the dam to the District of Columbia line. (*e*) Dr. section of R. between the dam and the District of Columbia line. (*f*) The depth of dr. to be such that the excavation and fill will approx. balance. (*g*) That draw spans be required in Pennsylvania Ave., Pennsylvania, Baltimore & Washington R. R., and Bennings Brs., available width to be 100′, as in the present Anacostia Br. (*h*) That the H. lines above Anacostia Br. be abolished and the bulkhead line just below Anacostia Br. be modified as indicated on map.

Est. cost of the reclamation, $2,046,100.

The operations during 1912 included a comprehensive study of the situation, including topographical and hydrographic surveys, investigation of stream flow and sedimentation, flood conditions, and sewage pollution.

Plans were in progress for beginning work of constr. with Government plant.

The total amount expended on the existing proj. to June 30, 1912, was $10,115.56. 12, 1342, 1343.

The District of Columbia app. act of July 1, 1902, app. $5,000, to be expended under the direction of the Sec. of War for making a survey and outline map of land owned by the U. S. within what is known as the flats of the Anacostia R. from its mouth to the boundary line of the District of Columbia, and au. and directed the Attorney General to report upon the nature of title to lands embraced within said flats. Survey made, and R. thereon by Lt. Col. Chas. J. Allen, Corps of Engineers, dated Feb. 17, 1903, with maps, transmitted to the Attorney General with a view to ex. and report pursuant to the law. 03, 36; 04, 19; 05, 20. H. D. No. 194, 59th, 1st. 06, 18.

APPROPRIATIONS.

July 1, 1902,	[1] $5,000, 03, 36.
Mar. 2, 1911,	100,000, 12, 3564.
June 26, 1912,	100,000, 12, 3564.
Total,	205,000

ENGINEERS.

Chief of Engineers. R., 03, 36; 04, 19; 05, 20; 06, 18; 12, 1342.

Boards. See above.

In charge. Lt. Col. W. C. Langfitt. R., 12, 3563.

MISC. 58. D. C.—LOTS, SALE OF—INTERSECTION OF K AND SIXTEENTH STREETS.

ENGINEERS.

Chief of Engineers. R., 81, 335.

Act Mar. 3, 1881, au. sale of lots. Appraisement made by 3 residents of Washington, D. C. Sales made to Messrs. Cook, Dickson, King, Boynton, et al. Total received, $7,452. 81, 335, 336.

MISC. 59. D. C.—MEMORIALS — McMILLAN MEMORIAL FOUNTAIN.

The sundry civil act approv. June 25, 1910, for the fiscal year 1911, contained the following item:

"For the preparation of the site, approaches, walks, foundation, and piping for the fountain to be erected in McMillan Park, in the District of Columbia, by the James McMillan Memorial Association of Michigan, $15,000."

By arrangement with the Commissioners of the District of Columbia the work provided for was performed under the officer in charge of the Washington Aqueduct, the site for the fountain being under control of the latter officer.

The work was completed during 1910–11, except the constr. of the granite work, under contract for $8,400, and which was finished in 1912.

No work done in 1911–12 on the ground toward the erection of the fountain by the James McMillan Memorial Association of Michigan; expected to be done during the following year.

APPROPRIATIONS.

See above.

ENGINEERS.

Chief of Engineers. R., 11, 1102; 12, 1318.

In charge. Lt. Col. W. C. Langfitt. R., 11, 2956; 12, 3467.

Assistants:

Capt. W. T. Hannum. 11, 1094; 12, 1311.

1st Lt. J. J. Bain. 12, 1311.

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[1] App. by D. of C.

MISC. 60. D. C. — MONUMENTS — WASHINGTON MONUMENT (1901-1912).

(For prior details, see Misc. 65 on p. 2072 of this index.)

1900–01. Usual care; addition to boiler house constr.; new electric elevator installed. Work of stiffening tie-rods of iron columns within which elevator car runs completed, and the 70-volt lamps in shaft replaced with lamps of 110 volts. **01,** 3696, 3728.

1901–02. Usual care required for mainten. Painting ironwork in the interior, running new electric-light wires, and replacing 70-volt lamps with lamps of 110 volts. **02,** 597, 2723.

1902–03. Misc. work of painting, carpentry, plumbing, etc. **03,** 658, 2527.

1903–04. Struck by lightning; slight damage to motor room. **04,** 3910.

1904–05. New hoisting cables, new counterweight cables, new controller cable installed; two new 80-horsepower boilers purchased and placed. Reception room constr. on lower floor; iron folding gates and revolving door placed at entrance. **05,** 738, 2628.

1905–06. Interior ironwork painted. **06,** 820, 2120.

1906–07. 2 steel arms put in for equalizing the unequal expansion of the cables of the elevator, and usual care extended to shaft and machinery connected therewith. **07,** 841, 2310.

1907–08. New cast-iron sheaves placed at top for cables; new governor gears and shaft put in place on cable drum of elevator. Misc. repairs made about the shaft, the power house, and lodge house. **08,** 886, 2383.

1908–09. New cable placed; wooden sheathing replaced with tile; engines in power house overhauled and repaired. **09,** 930, 2347.

1909–10. Woodwork in motor room repaired and necessary painting done. Painting also done at lodge house and minor repairs to machinery at power house. **10,** 2672.

1910–11. Terrazo floor laid in waiting room of lodge house, wainscoting constr. around room, changes made in heating pipes, plumbing remodeled, etc. **11,** 1104, 2980.

1911–12. Iron and woodwork in shaft painted and new sash made and painted for windows at top. **12,** 1321.

MISC. 61. D. C.—PARKS, PUBLIC RESERVATIONS, ETC. (1901-1912).

(See Misc. 65 on p. 2072 of this index.)

1900–01. Total area of parks, 407.21 acres. **01,** 3701.

At the propagating gardens necessary repairs made to greenhouse structures, additional propagating house constr., frame work of one of the greenhouses rebuilt, new office building erected, and grounds around it improved: some old iron fencing erected, part of Fifteenth St. roadway graded, etc. About 984,000 plants propagated for stock and park decoration. **01,** 675, 3715, 3730.

Usual care extended to improved parks and park places. 20 of the small unimproved reservations, containing 2.91 acres, brought to the first stage of improvement, and 3 of the small improved reservations further improved. Marking sts. placed at corners of 70 reservations, and Truxtun Circle highly improved. New entrance constr. to one of the main roadways in the monument grounds. Aspahlt pavements in parks extended by constr. of 2,410 sq. y. of asphalt footwalk, 240 sq. y. of asphalt roadway and 455 sq. y. asphalt footwalk repaired and resurfaced. **01,** 676, 3723. 56′ cobblestone gutter constr., and 438′ drainpipe and 1,092′ water pipe laid. **06,** 675, 3700.

Damages to Executive Mansion grounds by fire to inaugural stands. Recom. that refusal be made to allow erection in future or committees be required by law to give bonds and guaranty. **01,** 3704. Data relating to principal city parks in the U. S. **01,** 3711. Occupancy of reservations by committee on inaugural ceremonies. **01,** 3715. Plan for improving section s. of Pennsylvania Ave. and n. of B St. SW. and for a suitable connection between Potomac and Zoological Parks. Printed in Doc. No. 135, H. R., 56th, 2d. s. **01,** 3719, 3729.

1901–02. Repairs to greenhouses; plant house constr.; greenhouses remodeled and rebuilt; 784,000 plants propagated; 22,000 c. y. earth received and spread in propagating gardens. Asphalt pavements in parks extended by constr. of 1,401 sq. y. footwalk; 1,663 sq. y. repaired and resurfaced; 561′ iron drainpipe and 1,959′ water pipe laid; 148′ st. curb laid; cobblestone gutter, cinder footwalk, board footwalk constr., posts and fences painted. **02,** 597, 2726.

1902–03. Mainten. and care of parks and improved places; part of Potomac Park extensively improved by grading; constr. a macadam roadway, etc. In various parks curb set, fountains erected, asphalt pavements extended, footwalk, asphalt roadway repaired and resurfaced. At propagating gardens necessary repairs made; over

1,000,000 plants propagated. **03,** 659, 2531. Recom. for increased schedule of pay for park watchmen. **03,** 2536. 36th national encampment of the G. A. R. permits granted. **03,** 2549. Notes on public playgrounds, etc., by Geo. H. Brown, landscape gardener. **03,** 2666. Notes on Codiæums by Geo. H. Brown. **03,** 2669.

1903–04. Misc. work of mainten. (as described in former years); reservations relinquished to eliminate grade crossings and provide for constr. of a union railroad station; list given. **04,** 3913. Coping constr., sod laid, trees and shrubs planted, baseball diamond laid off, band concerts held, work on Potomac Park in progress, asphalt pavement constr., etc. **04,** 3924. Over 1,000,000 propagated. **04,** 3943. Notes on historic trees of Washington. **04,** 4046; **05,** 738, 2631; **06,** 820, 2122; **07,** 841, 2312.

1904–05. Use of Monument Grounds by American Railway Appliance Exhibition. **05,** 2654. Description of rare tropical plants. **05,** 2756. List of trees and shrubs in some of the public parks. **05,** 2757.

1905–06. Report on "The City Parks and Park Places" by Geo. H. Brown, landscape gardener. **06,** 2238.

1906–07. Constr. of macadam roadway along the n. and w. sides of tidal reservoir in Potomac Park. **07,** 2328.

1907–09. Additional spaces transferred, reservations imp., work of imp. E. Potomac Park completed, cement coping constr., gravel roadway in President's Park resurfaced, Garfield Park remodeled, asphalt walk repaired, etc. **08,** 886, 2385; **09,** 930, 2335. At propagating gardens, various greenhouse structures repaired; 690,000 plants propagated. **09,** 930, 2349.

1909–12. Usual care and mainten. work; macadam driveway along North B St. completed; work for imp. interior portion Potomac Park accomplished; coping constr.; walks laid; gravel road resurfaced. **10,** 1041, 2658. Over 680,000 plants propagated. **10,** 2676; **11,** 1103, 2965; **12,** 1320, 3486. Over 670,000 plants propagated. **12,** 1321, 3503.

MISC. 62. D. C.—PARKS—LIGHTING (1900–1912).

(See Misc. 65 on p. 2072 of this index.)

1900–01. Lights in parks and grounds maintained in good condition, minor repairs made, and old lanterns replaced. **01,** 3722; **03,** 2567; **04,** 3953; **05,** 2659; **06,** 2147; **08,** 2409; **09,** 2352; **11,** 2973. New improved system of lighting parks adopted and installation nearly completed. **12,** 1320.

MISC. 63. D. C.—PARKS—POTOMAC PARK (1908–1912).

1908–09. Mainten. of imp. portions, grading, macadam roadway, cinder footwalk, drainpipe laid, etc. **09,** 2355; **10,** 2669. Monument grounds; misc. work of filling fishponds, roadway constr., cinder paths laid, etc. **10,** 2673; **11,** 2978; **12,** 3501.

MISC. 64. D. C.—FISHWAYS AT GREAT FALLS.

APPROPRIATIONS.

1882, $50,000, **83,** 339, 2092; **87,** 2565.
1888, 25,000, **88,** 312, 2766.
1892, 15,000, **93,** 4310.
Total, 90,000

CONTRACTS.

J. E. Lyons, fishway constr. **85,** 2500.

1891. T. Hathaway, constr. of fishways, $31,908. **91,** 3906.

ENGINEERS.

Chief of Engineers. **R., 83,** 339; **84,** 344; **85,** 374; **86,** 368; **87,** 335; **88,** 312; **89,** 380; **90,** 348; **91,** 443; **92,** 417; **93,** 479; **94,** 435; **95,** 489.

In charge:

Maj. G. J. Lydecker, 1883–89. **R., 83,** 2092; **84,** 2311; **85,** 2499; **86,** 2061; **87,** 2564; **88,** 2766.

Col. J. M. Wilson, 1889–90. **R., 89,** 2825.

Lt. Col. G. H. Elliot, 1890–92. **R., 90,** 3532; **91,** 3905; (Col.) **92,** 3382; **93,** 4310; **94,** 3224.

Maj. J. G. D. Knight. **R., 95,** 4114.

Assistant. Capt. T. W. Symons. **R., 84,** 2312; **85,** 2500; **86,** 2063.

OPERATIONS.

1885–86. Work upon fishways commenced under contract, but abandoned after destruction of unfinished portion by flood. **86,** 2061.

1886–87. Reconstr. of dam. **87,** 2564.

1891–92. Fishways in process of constr. **92,** 3382.

PROJECT.

By Maj. Lydecker, 1883, for erection of fishways at Great Falls of the Potomac R.; est., $34,160.19; **85,** 2499; **87,** 2565.

SURVEYS.

Maps. **84,** 2321, 2336.

MISC. 65. D. C.—PUBLIC BUILDINGS AND GROUNDS.

(See Misc. 43-84 on p. 2039-2040 of this index.)

NOTE.—In addition to care, etc., of public grounds and buildings, the office was charged at 1900 with—

Care and repair of the Government telegraph lines connecting the Capitol with the various departments and the Government Printing Office.

Repair and imp. of the Government Printing Office.

Repair of the building on Tenth St. NW., where Abraham Lincoln died.

Constr. of the statue of Gen. J. A. Logan.

Care of such matters connected with the erection of the statue of Gen. Sherman as properly devolved upon the War Department.

Care of the monument at Wakefield, Va., the birthplace of Washington.

Care of the iron-pile dock erected under the supervision of the office in 1894, under the direction of the Department of State, at the mouth of Bridge Creek, Va.

The erection in the National Military Park at Gettysburg, Pa., of the memorial tablet to Abraham Lincoln.

Preservation, care, and safety of buildings occupied by the War Department in the District, except State, War, and Navy Department Building.

Care of the banks of the Potomac R. from the n. line of the Arsenal grounds to the s. curb line of N St.

The work, since June 15, 1900, of continuing plans for extending the Executive Mansion.

The work, since June 20, 1900, of making an ex. and reporting plans for the treatment of that section of the District situated s. of Pennsylvania Ave. and n. of B St. SW., and for a suitable connection between the Potomac and Zoological Parks.

At 1912 the various duties assigned to the officer in charge of public buildings and grounds were as follows:

Mainten., care, and repair of the Executive Mansion, grounds, and greenhouses. (See Misc. 56.)

Imp., policing, care, and mainten. of various parks and reservations in the District of Columbia. (See Misc. 61.)

Imp., care, and mainten. of the portion of Potomac Park w. of the R. R. embankment.

Care and mainten. of the Washington National Monument. (See Misc. 60.)

Care and mainten. of the propagating gardens.

Care of the building No. 516 Tenth St. NW., where Abraham Lincoln died. (See Misc. 54.)

The preservation, care, and safety of buildings occupied by the War Department in the District of Columbia, except State, War, and Navy Department Building.

Care and repair of the Government telegraph line connecting the Capitol with the various departments and Government Printing Office. (See Misc. 72.)

Care and mainten. of the highway bridge across the Potomac R., D. C. (See Misc. 43-50.)

Furnishing and planting trees, shrubs, etc., in the grounds of the Library of Congress, of the Capitol, and of executive departments.

The immediate charge of the banks of the Potomac R. from the n. line of the arsenal (or Washington Barracks) grounds to the s. curb line of N St. SW. (See Misc. 61-63, 66-67, 84.)

Care of the monument at Wakefield, Va., the birthplace of Washington, and the iron-pile dock at the mouth of Bridge Creek, Va.

The duties of executive and disbursing officer of the following commissions:

Grant Memorial Commission.

Barry Statue Commission.

John Paul Jones Statue Commission.

Columbus Memorial Commission.

Lincoln Memorial Commission.

In charge of the monument at Fredericksburg, Va., to the memory of Gen. Hugh Mercer.

Member of the commission created by the public buildings act approved May 30, 1908, to cause plans and ests. to be prepared for a suitable armory for the National Guard of the District of Columbia.

Secretary, executive and disbursing officer of the Commission of Fine Arts, created by act approved May 17, 1910.

Member of board of engineers to prepare and approve plans for the reclamation and development of the Anacostia R. and Flats. (See Misc. 57.)

Military aide to the President.

ENGINEERS.

Chief of Engineers. **R.**, **67**, 52; **68**, 74; **69**, 65; **70**, 84; **71**, 100; **72**, 98; **73**, 109; **74**, 120; **75**, 126; **76**, 116; **77**, 124; **78**, 139; **79**, 183; **80**, 243; **81**, 334; **82**, 324; **83**, 339; **84**, 344; **85**, 374; **86**, 368; **87**, 336; **88**, 312; **89**, 381; **90**, 349; **91**, 444; **92**, 418; **93**, 480; **94**, 435; **95**, 491; **96**, 437; **97**, 542; **98**, 546; **99**, 632; **00**, 710; **01**, 675; **02**, 596; **03**, 658; **04**, 730; **05**, 738; **06**, 820; **07**, 841; **08**, 885; **09**, 929; **10**, 1041; **11**, 1103; **12**, 1319.

In charge:

Maj. N. Michler (Bvt. Brig. Gen.). **R.**, **67**, 519, 532 (public park and site of Presidential Mansion), 544 (foreign paving); **68**, 889, 913 (survey, Potomac R. in District of Columbia); **69**, 493, 498 (Washington Canal, Tiber Creek), 517 (probable damage to Georgetown or Virginia chan. from repair of R. R. br.); **70**, 517, 530 (ex. of Potomac); **71**, 974.

Maj. O. E. Babcock. **R.**, **71**, 967; **72**, 1010, 1026 (description of grounds); (Col.) **73**, 1151; **74**, ii, 385; **75**, ii, 800; **76**, ii, 675; **77**, ii, 1061.

Lt. Col. T. L. Casey. **R.**, **77**, ii, 1072; **78**, ii, 1345; **79**, ii, 1877; **80**, 2339.

Col. A. F. Rockwell. **R.**, **80**, 2339; (Col.) **81**, 2711; **82**, 2733; **83**, 2093; **84**, 2339.

Lt. Col. J. M. Wilson. **R.**, **85**, 2503; **86**, 2075; **87**, 2569; **88**, 2769; **89**, 2827.

Col. O. H. Ernst. **R.**, **90**, 3535; **91**, 3907; **92**, 3385.

Col. J. M. Wilson. **R.**, **93**, 4313; **94**, 3265 (including list of U. S. reservations in Washington); **95**, 4129; **96**, 3975.

Col. T. A. Bingham. **R., 97,** 4025; **98,** 3661 (erection of Government Printing Office; including records of Washington Monument, changes in ironwork); **99,** 3811; **00,** 5227; **01,** 3689; **02,** 2717; **03,** 2517.

Col. A. M. Miller. **R., 04,** 2899.

Col. C. S. Bromwell. **R., 05,** 2619; **06,** 2112; **07,** 2300; **08,** 2376.

Col. Spencer Cosby. **R., 09,** 2329; **10,** 2653; **11,** 2959; **12,** 3481.

Assistant. Lt. J. S. Sewell. **R., 96,** 4004.

MAPS, PLATES, ETC.

Map of the city of Washington, D. C., showing reservations, etc. **84,** 2371.

River front, Washington, D. C. **86,** 2098.

Maps of the various parks in Washington, D. C. **86,** 2098.

Reservations. **87,** 2612; **94,** 3314; **00,** 5237, 5242; **02,** 2728.

Tunnel, water supply, city of Washington. **88,** 2766.

National road to Mount Vernon. **90,** 3580.

Various reservations. **94,** 3272. President's Park. **94,** 3274.

Capitol spring water piping. **96,** 3994.

Washington Monument. **98,** 3666. Views from. **98,** 3668. Power-house layout. **98,** 3668.

President's Park, view. **98,** 3727.

Fountains, at night. **98,** 3732; **99,** 3824. Study for. **00,** 5241.

Ground plan, Executive Mansion. **99,** 3814.

White House Conservatory, west "L." **99,** 3814.

Blizzard, 1899, White House Grounds. **99,** 3814.

Washington Monument—Tie rods strengthened; as Monument looked before 1878; "present view." **99,** 3819.

Copings. **99,** 3826.

Propagating gardens. **99,** 3834.

Monument Grounds. **99,** 3834.

Washington Circle. **99,** 3834.

McPherson Square. **99,** 3834.

Subfoundation, Sherman Statue. **99,** 3840.

Wharves and harbor lines. **99,** 3844.

White House. **00,** 5228, 5230, 5232.

Uniform of park watchmen. **00,** 5244.

Easter Monday egg rolling, White House. **00,** 5244.

Guide to trees and shrubs, White House. **00,** 5249.

Bronze vase, Lafayette Square. **00,** 5252.

Toolhouse, President's Park. **00,** 5252.

Map of the city of Washington, showing U. S. reservations. **01,** 3700; **02,** 3728.

Photograph, new office at propagating gardens, 1901. **01,** 3716.

Sketch, proposed development of propagating gardens, greenhouses, and nursery. **01,** 3718.

Sketches, the Mall, as proposed by Pierre L'Enfant. **01,** 3718.

Sketch study for embellishment and use of Potomac Park. **01,** 3718.

Sketch, Grant Memorial site. **01,** 3758.

Photographs, propagating gardens, looking w. on C St. between storehouse and shops; new storehouse, Fifteenth St. side, garden side. **02,** 2736. Old carpenter shop; old blacksmith shop; old plumber's and paint shop; new shops. **02,** 2739.

Sketch, plan for imp. Monument Park. **02,** 2738.

Photograph, Rochambeau Statue. **02,** 2741.

Photograph, varieties of codiaeums of propagating gardens. **02,** 2519.

Photographs, exterior and interior of Executive Mansion. **02,** 2522.

Sketch, White House, Executive Office and Grounds. **03,** 2526.

Photographs, old canal lock, entrance to Potomac Park, main entrance to Potomac Park, old canal lock house, Seventeenth and B Sts., new roadway, Potomac Park. **03,** 2554.

Photographs of following statues: Gen. Andrew Jackson, center of Lafayette Park; Gen. Washington, Washington Circle; Gen. John A. Rawlings, Pennsylvania Ave.; Gen. Winfield Scott, Scott Circle; Abraham Lincoln, in front of U. S. Courthouse; Abraham Lincoln, Lincoln Park; Maj. Jas. B. McPherson, McPherson Square; Gen. Nathanael Greene, Stanton Park; Maj. Gen. Geo. H. Thomas, Thomas Circle; Admiral Farragut, Farragut Square; Prof. Joseph Henry, Smithsonian grounds; Admiral Du Pont, Du Pont Circle; President Garfield, Maryland Ave. and First St. NW.; Gen. Lafayette and compatriots, Lafayette Park; Gen. Winfield Scott Hancock, Hancock Place; L. J. M. Daguerre, Smithsonian grounds; Dr. Samuel D. Gross, Smithsonian grounds; Daniel Webster, Massachusetts Ave. between Sixteenth and Seventeenth Sts. NW.; Gen. John A. Logan, Iowa Circle; Dr. Samuel Hahneman, Massachusetts Ave.; Albert Pike, Indiana Ave.; Rochambeau, southwest corner of Lafayette Park; Gen. Ulysses S. Grant (model).

Sketch, section 1, Arsenal Grounds to N St. **03,** 2570.

Photograph, tree planted by President Roosevelt, e. entrance White House Grounds; tree planted by Mrs. Roosevelt, e. entrance White House Grounds. **04,** 3901. China cabinet, and display of White House china. **04,** 3904. Colonial gardens, White House Grounds, e. side, also w. side. **04,** 3908.

Sketch, park coping concrete. **04,** 3918.

Photographs, Sherman Statue. **04,** 3948.

Sketch, plan of Sherman Statue and grounds. **04,** 3948.

Photographs, new plants in gardens. **05,** 2621. Potomac Park driveway. **05,** 2646. Statue representing "Victory," antique decorative urn. **05,** 2654. Sherman Plaza. **05,** 2655.

Sketch, general plan of White House, Executive Office, and Grounds, showing the location of the shrubs and trees, of various parks and circles. **05,** 2772.

Photographs, view of Potomac Park from highway embankment, of Potomac Park nursery, of new riverside drive. **06**, 2136.

Sketch, Potomac Park, development and utilization. **06**, 2137.

Photographs, Mercer monument and grounds, Fredericksburg, Va. **06**, 2146.

Photograph, view of Potomac Park Basin drive. **07**, 2328.

Photographs, views of McClellan Statue, as completed; of statue (veiled) and stands; of statue unveiled. **07**, 2338.

Sketch, showing waterside drives. **08**, 2400.

Photograph, view of riverside drive looking se. to inlet, of riverside drive looking nw. to N. B St., of Riverside Drive Circle, looking se., of old sewer canal. **08**, 2400.

Sketch, W. Potomac Park, N. B St. extended, and the inlet br. **09**, 2356.

Photograph, view of the new inlet br., Potomac R. side. **09**, 2357.

Photographs, the Sheridan Statue, Sheridan Circle, unveiling ceremonies. **09**, 2360. The Longfellow Monument. **09**, 2364. The Stephenson Monument; the John Witherspoon Monument. **09**, 2366.

Photographs, view of the Executive Office Building, of the President's Office. **10**, 2656. Wading pool and children's playground, Garfield Park. **10**, 2662. Inlet br., tidal basin, Potomac Park. **10**, 2670. View of Pulaski Monument, and Kosciuszko Monument. **10**, 2689.

Photograph, landscape imp. at Thomas Circle. **11**, 2969. Revised landscape setting of Webster Statue. **11**, 2970. New entrance, Lincoln Park. **11**, 2972.

Sketch, Reservation 126, playground and park treatment. **11**, 2972.

Photographs, Von Steuben Monument, and unveiling of monument. **11**, 2990.

Photographs, fountain and terrace at W. Twenty-second St. **12**, 3490.

Photographs, Neighborhood Park at Mount Pleasant. **12**, 3492. John Paul Jones Monument. **12**, 3514. Columbus Memorial, Union Station Plaza. **12**, 3515.

OPERATIONS.

Each an. report gives these in detail.
See "Special Reports" below.

SPECIAL REPORTS.

Public park and site of Presidential Mansion. R., Maj. N. Micheler. **67**, 532.

Remarks on the vegetation of the District of Columbia. Dr. Arthur Schott, Georgetown. **67**, 538.

Public park for the Capital. Speech by Hon. B. Gratz Brown. **67**, 542.

Public pavements, suggestions for. Gen. M. C. Meigs. **67**, 544 (with plates).

List of trees and shrubs. G. H. Brown, public gardener. **86**, 2099.

Public reservations. **87**, 2593; **94**, 3272, 3295; **01**, 3701.

List of deciduous trees and shrubs. **90**, 3556. Evergreen trees and shrubs. **90**, 3561.

National Road to Mount Vernon. Lt. Col. P. C. Hains. **90**, 3563.

List of buildings, etc., in charge of Superintendent of Public Buildings and Grounds. **94**, 3268, and in subsequent reports.

Old records of city of Washington, and reservations occupied in violation of law. **96**, 3997, and subsequent years.

New building, Government Printing Office. 1st Lt. J. S. Sewell. **96**, 4004.

Regulation for protection of the national park grounds in the District of Columbia. **97**, 4061; **98**, 3661.

Washington Monument statistical records—levels—plummet—bench mark—record of plumb-line. **98**, 3669. Changes in iron framework. **98**, 3716; **00**, 5236. Levels. **01**, 3698; **02**, 2725.

Parks of Washington, in relation to parks of other cities. **99**, 3824; **00**, 5238.

Future of parks in Washington. **99**, 3824.

U. S. wharf property, Washington, D. C. **99**, 3843, and subsequent years.

List of trees and shrubs, Executive Mansion. H. Pfister, head gardener. **00**, 5245.

Legal status, Office Public Buildings and Grounds. **00**, 5273.

List of records of city of Washington. **00**, 5281.

List of trees, shrubs, etc., public grounds. G. H. Brown. **00**, 5286.

Extension of White House. **01**, 3693.

Washington Monument—electric plant. **01**, 3698.

Principal parks of U. S.—data. **01**, 3710.

Inventory, White House contents. **01**, 3736; **02**, 2754; **03**, 2582; **04**, 3970; **05**, 2674; **06**, 2164; **07**, 2358; **08**, 2430; **09**, 2378; new method, **10**, 2655.

Address, Col. T. A. Bingham, centennial exercises, East Room, White House, Dec. 2, 1900. **01**, 3754.

Program, competition for Grant Statue or Memorial. **01**, 3756.

Program, competition, McClellan Statue. **01**, 3758.

Special index to annual report. Begins with **01**, 3759.

Remodeling White House. **02**, 2721.

Office building for the President. **02**, 2722.

Washington Monument—distribution of weights. **02**, 2725. Data relative to. **02**, 2726; **03**, 3911; **04**, 3911; **05**, 2630; **06**, 2121; **07**, 2311; **08**, 2384; **09**, 2348; **10**, 2672; **11**, 2981; **12**, 3503.

Notes on the chrysanthemum. G. H. Brown. **02**, 2760.

Potomac Park (portion) transferred to Office of Public Buildings and Grounds. **03**, 2552.

List of statues. **03**, 2559; **04**, 3946.

Notes on public playgrounds. G. H. Brown. **03**, 2666.

Notes on codiaeums. G. H. Brown. **03**, 2669.

Reservations relinquished to provide for Union Railroad Station, and transferred for various purposes. **04**, 3913; **05**, 2632.

Notes on historic trees of Washington, D. C. **04**, 4046.

Band concerts begun. **05**, 2648.

Reservations occupied by inaugural committee. **05**, 2652.

Historic statues presented by inaugural committee. **05**, 2653.

Sherman Plaza. **05**, 2655.

Description, rare tropical plants, propagating gardens. **05**, 2756.

Trees and shrubs, by their various names, in D. C. public parks. **05**, 2757.

City parks, and park places, D. C. G. H. Brown. **06**, 2238.

Extraordinary repairs, White House. **07**, 2306.

Roadway, Potomac Park. **07**, 2327.

Building for offices of the President. **10**, 2657.

Commission of Fine Arts. **10**, 2687.

Columbus Memorial au. act Mar. 4, 1907. **12**, 3514.

Lincoln Memorial au. act Feb. 9, 1911. **12**, 3515.

MISC. 66. D. C. — RESERVATIONS, OCCUPANCY OF (1900-1912).

(See Misc. 67 on p. 2075 of this index.)

1900-01. 158,624 sq. f. given to Baltimore & Potomac R. R.; 66,156 sq. f. given to Baltimore & Ohio R. R. **01**, 3726. Reservations occupied for inaugural purposes. **09**, 2859.

MISC. 67. D. C.—RESERVATIONS OCCUPIED IN VIOLATION OF LAW.

1900-12. List of names of persons occupying such reservations. **01**, 3725; **02**, 2745; **03**, 2570 **04**, 3957; **05**, 2661; **06**, 2151; **07**, 2344; **08**, 2416; **09**, 2367; **10**, 2690; **11**, 2996; **12**, 3518.

MISC. 68. D. C. — ROADS — FROM AQUEDUCT BRIDGE TO MOUNT VERNON.

Note.—This relates to a proposed national boulevard connecting Arlington with Mount Vernon. Several reports with plans and ests. have been submitted since 1886. The Chief of Engineers earnestly recom. congressional action.

Act Feb. 23, 1889, au. Sec. of War to have surveys made, and est. prepared. **89**, 385, 2867; **00**, 43.

APPROPRIATION.

1889, $10,000, **89**, 2867.

ENGINEERS.

Chief of Engineers. R., **89**, 385; **90**, 350; **99**, 42; **00**, 43.

In charge. Lt. Col. C. P. Hains. R., **89**, 2867; **90**, 3563.

Assistant. B. F. Mackall. R., **90**, 3571.

MISC. 69. D. C. — ROADS — CONDUIT ROAD, RECONSTRUCTION.

Note.—The Conduit Road is approx. 12½ m. l. from Foxhall Road to Great Falls, and is a necessary feature of the operation and mainten. of the conduit (water-supply system, D. C.), especially while awaiting the constr. of public roads on either side.

Its advantages were early appreciated, the officer in charge reporting in 1868 that it should be macadamized as soon as practicable.

Between 1870–1875, $46,000 were app. for this purpose, and 9.4 m. surfaced.

Since the latter date but $4,000 have been especially app. for the road, the last of which was $2,000 in 1900.

The small amounts spared from the regular app. have been wholly and totally inadequate for mainten. alone..

By act of Congress approv. June 26, 1912, an app. of $15,000 was made for beginning the surfacing and imp. of the Conduit Road from Foxhall Road to Great Falls during the fiscal year 1913. Est. that about $30,000 additional needed to complete this work. 11, 1096; 12, 1314.

APPROPRIATIONS.

See above.

ENGINEERS.

Chief of Engineers. R., 11, 1096; 12, 1314.

In charge. Lt. Col. W. C. Langfitt. R., 11, 1094, 2942; 12, 3463.

Assistants:

Capt. W. T. Hannum. 11, 1094; 12, 1311.
1st Lt. J. J. Bain. 12, 1311.

MISC. 70. D. C.—STATUES (1900–1912).

(See Misc. 65 on p. 2072 of this index.)

1900–01. There are 21 statues in national public grounds in charge of this office. Statues of Gen. Logan and Albert Pike completed; former unveiled. Granite coping set in position about two-thirds of the way around the site of Gen. Sherman, and statue work continued. Lettering on statue of Daniel Webster regilded. Congress app. $10,000 for statue to Gen. U. S. Grant; designs solicited. Congress app. $50,000 for site and statue of late Maj. Gen. Geo. B. McClellan. 01, 3720. Program of competition for Grant Statue or Memorial, Washington, D. C. 01, 3756. Of equestrian statue of late Maj. Gen. George B. McClellan. 01, 3758.

1901–02. Statue of Rochambeau and pedestal for same erected. 02, 597, 2740.

1902–03. Table of statues in public grounds. 03, 2560; 04, 3946. Details of work on various statues. 03, 2563.

1903–04. Sherman Statue completed and unveiled. 04, 3948. Contract for Grant Statue entered. 04, 3949. Details of work on other statues given. 04, 3949.

1904–05. Historic statues presented by inaugural committee. 05, 2653. Work of imp. at "Sherman Plaza" completed. 05, 2655. Working model for McClellan Statue approv.; contract for erection of monument to Gen. Hugh Mercer entered into; other work on statues and memorials. 05, 2656.

1905–06. Models of some of the bronzework of Grant Memorial completed, approv., and site selected. Model of McClellan Statue completed and approv.; bronze casting of same completed and accepted. Sculptor given another opportunity to submit model for Pulaski Statue. Artist selected for statue of Baron von Steuben. Monument for Gen. Hugh Mercer, at Fredericksburg, Va., completed and grounds of site imp. 06, 820, 2144.

1906–07. Statue of Gen. McClellan completed, erected, and unveiled; the full-size models of the bronze lions for the Grant Memorial completed; a model of the Pulaski Statue approv.; contract entered into for the Von Steuben Statue. Model selected or the statue of Kosciuszko and a site selected for the statue of Longfellow. 07, 842, 2337.

1907–08. Foundation for Grant Statue nearly completed; contract entered into for Sheridan Statue and Pulaski Statue; progress made with models for Von Steuben Statue; full-size model for Kosciuszko Statue completed; site and sculptor selected for John Paul Jones Statue; site selected for statue to Commodore Barry; and other misc. work on statues and memorials. 08, 886, 2410.

1908–09. The statues of Gen. Philip H. Sheridan, Henry Wadsworth Longfellow, and John Witherspoon, and the Stephenson Grand Army Memorial were erected and completed, and all but the latter unveiled. The architectural portion and some of the bronze sculpture of the Grant Memorial were finished. Site selected for the statue of Commodore John Barry, and models were submitted in a competition for that statue; a new site was selected and contract entered into for the statue of John Paul Jones, and progress was made on the models for the Pulaski and the Von Steuben Statues. 09, 930, 2359.

1909–10. Statues of Gen. Count Pulaski and Gen. Thaddeus Kosciuszko erected, completed, and unveiled; full-size model of artillery group for memorial to Gen. U. S. Grant completed and approv., and will now be cast in bronze; full-size model of artillery group for memorial to Gen. von Steuben completed, cast in bronze, received in Washington and stored; other misc. work. **10**, 1042, 2682.

1910-11. Statue of Gen. Baron von Steuben erected, completed, and unveiled; full-size model of artillery group for memorial to Gen. U. S. Grant sent to foundry to be cast in bronze; sculptor selected for Commodore John Barry Statue; plaster models statue of John Paul Jones and bas relief for pedestal completed by sculptor and approv.; scale model for Columbus Statue approv. **11**, 1105, 2989.

1911-12. Monument to John Paul Jones erected, completed, and unveiled; also memorial to Christopher Columbus. Group for Grant Memorial cast in bronze and placed in position upon pedestal; contract entered into for constr. and erection of Commodore Barry Statue. **12**, 1321, 3510.

MISC. 71. D. C.—TELEGRAPH AND TELEPHONE WIRES—PUTTING UNDERGROUND.

ENGINEERS.

Chief of Engineers. R., **88**, 312.

In charge. Lt. Col. J. M. Wilson. **R.** (Sen. Ex. D. 153, 50th, 1st), **88**, 313, 2794.

PLANS.

R. on comprehensive system of underground wires for telegraph and telephone service to connect the several departments and bureaus of the U. S. in Washington called for by Senate resolution, Mar. 26, 1888, together with an est. of the cost. **88**, 313. For **R.**, see above. Est., $69,054.61. **88**, 2799.

MISC. 72. D. C.—TELEGRAPH AND TELEPHONES—PRIVATE DEPARTMENTAL CONNECTIONS.

ENGINEERS.

Chief of Engineers. R., **98**, 547; **99**, 633. (See also Misc. 71.)

In charge. Col. T. A. Bingham. **R.**, **98**, 3743; **99**, 3842; **00**, 5262. (See also Misc. 71.)

PROJECT.

Under an allotment of $7,000, Apr. 9, 1898, from app. for "National defense" (war), act Mar. 9, 1898, telephone circuits were constr. and completed between the White House and the executive departments, with some minor exceptions completed later. **98**, 547.

1900-05. Electric storage battery, in duplicate, purchased to replace the old-style gravity battery hitherto used. The desirability of replacing the "present" overhead system of wires with underground conduits and cables submitted for action of Congress and printed in H. D. No. 135, 56th, 2d; est., $30,000. **01**, 3724; **02**, 2743; **03**, 2568; **04**, 3954; **05**, 2659.

1905-06. Overhead cables of departmental telegraph line removed from roof of Treasury Department Building and brought into building through an underground conduit; other misc. work done. **06**, 821, 2148; **07**, 2414; **09**, 2353; **10**, 2677; **11**, 2985.

MISC. 73. D. C. — WATER SUPPLY — WASHINGTON AQUEDUCT (1850-1912).

Apps. for mainten. and operation of the Washington Aqueduct are applied to the imp., mainten., and repair of those parts of the water-supply system which are under the supervision of the Chief of Engineers. These are—

The masonry dam across the Potomac at Great Falls.

The works there for regulating the supply to the conduit.

The Conduit Road from Great Falls to Washington, a distance of about 14 m.

The conduit from Great Falls to the Georgetown Reservoir, a distance of about 12 m.

The 3 reservoirs for supplying the city.

The tunnel, about 4 m. l., connecting the Georgetown and McMillan Park Reservoirs.

The 2 brs. for carrying the mains across Rock Creek.

And other auxiliary works.

A description of these works may be found in the Annual Report of the Chief of Engineers, 1903, pages 2485–2487.

The original proj. for constr. of the Washington Aqueduct was dated Feb. 12, 1853, and published as Senate Ex. D. No. 48, 32d, 2d. The proj. provided for supplying the city of Washington with water taken from the Potomac R. at Great Falls, Md., about 14 m. above the city and 16½ m. from the present filtration plant, and with water from Little Falls Branch. Work was begun in 1853, and in 1859 water from Little Falls Branch was supplied to the city through the conduit. The first Potomac water was supplied to the city in December, 1863.

The water from Little Falls Branch became polluted, and works for excluding it were completed in 1895. The dam at Great Falls was raised during 1896 and the capacity of the system increased to its "present" extreme limit of 90,000,000 gallons per day, or, making allowances for sudden increases in consumption, to a safe limit of 65,000,000 gallons. For a discussion of the capacity of the system, see Annual Reports of the Chief of Engineers for 1897, pages 3991–4014; for 1906, pages 2093–2095; and for 1909, pages 2310–2311.

As explained in the report of the officer in charge of the Washington Aqueduct for the fiscal year ending June 30, 1911, the usual app. of $33,000 is not sufficient to provide for the proper mainten. of the aqueduct and its accessories, and the amount is increased, in ests. submitted, to $38,000, thus providing $5,000 for maintaining the Conduit Road in good condition when once placed in such condition; the character and amount of traffic, especially of automobiles, has caused its rapid deterioration.

Br. No. 6 across Rock Creek is no longer an integral part of the aqueduct system but is maintained solely for the benefit of the city. As this br. is entirely too narrow for the traffic passing over it and needs to be widened, its formal transfer to the city recom.

Prior to August, 1905, the mains leading to the city from the Georgetown (distributing) Reservoir were used for a gravity supply to a part of the city of Washington, and they were maintained by the U. S. On Aug. 21, 1905, as the filtration plant had been so far completed that a portion of it could be put into operation, the gates connecting the Georgetown Reservoir with the mains referred to were closed, and the entire flow of water for the section which they supplied was sent through the tunnel to the filtration plant and thence to those mains for distribution. They accordingly became an essential part of the city distribution system, and, by mutual agreement, they have since been operated and maintained by the city water department. Their formal transfer to the city recom. **12**, 1312, 1313.

APPROPRIATIONS.[1]

Sept. 30, 1850	$500.00
Aug. 31, 1852	5,000.00
Mar. 3, 1853	100,000.00
Mar. 3, 1855	250,000.00
Aug. 18, 1856	250,000.00
Mar. 3, 1857	1,000,000.00
June 12, 1858	800,000.00
June 25, 1860	500,000.00
July 4, 1864	150,000.00
July 28, 1866	142,584.00
Dec. 20, 1866	12,000.00
Mar. 2, 1867	20,000.00
July 20, 1868	10,000.00
July 25, 1868	52,500.00
Mar. 3, 1869	25,000.00
July 15, 1870	120,822.00
Mar. 3, 1871	114,196.00
June 10, 1872	70,555.00
Jan. 23, 1873	14,000.00
Mar. 3, 1873	43,600.00
June 23, 1874	36,400.00
Mar. 3, 1875	26,000.00
July 31, 1876	22,000.00
Mar. 3, 1877	15,000.00
June 20, 1878	15,000.00
July 1, 1879	20,000.00
June 4, 1880	20,000.00
Mar. 3, 1881	20,000.00
July 1, 1882	20,000.00
July 15, 1882	1,485,279.30
Mar. 3, 1883	20,000.00
July 5, 1884	20,000.00
July 7, 1884	87,500.00
Feb. 25, 1885	87,500.00
Mar. 3, 1885	20,000.00
Mar. 26, 1886	5,000.00
July 9, 1886	20,000.00
Aug. 4, 1886	555,000.00
Mar. 3, 1887	20,000.00
Mar. 30, 1888	355,000.00
July 18, 1888	20,000.00
Mar. 2, 1889	595,000.00
Aug. 6, 1890	25,500.00
Sept. 30, 1890	48,396.78
Mar. 3, 1891	20,000.00
July 14, 1892	20,000.00
Mar. 3, 1893	80,000.00
Aug. 7, 1894	82,500.00
Aug. 18, 1894	4,000.00
Mar. 2, 1895	71,500.00
June 11, 1896	25,000.00
Mar. 3, 1897	26,000.00
June 30, 1898	322,210.50
Mar. 3, 1899	230,000.00
June 6, 1900	176,034.34
Total	8,296,577.92
Received from sale of land, etc., prior to 1880; reverted to app	15,651.39
	8,312,229.31
Reverted to Treasury	38,048.27
Net amount expended	8,274,181.04

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[1] Taken from **12**, 3461.

APPROPRIATIONS—Continued.

Appropriations, 1901-11, inclusive.

Mar. 1, 1901		$184,222.97
July 1, 1902		102,490.00
Mar. 3, 1903		33,000.00
Apr. 27, 1904		33,000.00
Mar. 3, 1905		33,000.00
June 27, 1906		33,000.00
Mar. 2, 1907		102,000.00
May 26, 1908		43,000.00
May 26, 1908		[1] 6,000.00
Mar. 3, 1909		33,000.00
May 18, 1910		69,500.00
Mar. 2, 1911		131,000.00
Total		803,212.97
Reverted to Treasury	$12,194.48	
Outstanding liabilities, June 30, 1912	7,778.24	
		19,972.72
Net amount expended, 1901–12		783,240.25
Net amount expended, 1850–1900		8,274,181.04
Total net expended		9,057,421.29
(a) For constr.		7,876,324.44
For operation, mainten., and repairs		1,181,096.85
(b) Paid by the U. S		6,433,862.93
Paid by D. C		2,623,558.36

ENGINEERS.

Chief of Engineers. **R., 67,** 52; **68,** 74; **69,** 65; **70,** 84; **71,** 99; **72,** 98; **73,** 109; **74,** 120; **75,** 126; **76,** 116; **77,** 124; **78,** 139; **79,** 184; **80,** 243; **81,** 334; **82,** 324; **83,** 338; **84,** 342; **85,** 372; **86,** 365; **87,** 333; **88,** 310; **89,** 378; **90,** 345; **91,** 436; **92,** 413; **93,** 475; **94,** 432; **95,** 485; **96,** 430, 3932; **97,** 537; **98,** 542; **99,** 629; **00,** 705; **01,** 671; **02,** 593; **03,** 654; **04,** 726; **05,** 734; **06,** 815; **07,** 836; **08,** 879; **09,** 923; **10,** 1035; **11,** 1094; **12,** 1311.

Boards:

Commission of experts on aqueduct tunnel. **R., 96,** 3932. (Maj. W. L. Marshall, Capt. J. L. Lusk, and Capt. D. D. Gaillard, Corps of Engineers; A. Fteley and D. Fitzgerald, civil engrs.) Reports of others on the subject: Col. G. H. Elliot (retired). **96,** 3944. Gen. M. C. Meigs. **96,** 3949. Maj. J. G. D. Knight. **96,** 3950. T. B. Main and A. J. Sparrow. **96,** 3942.

In charge:

Under War Department—
Capt. M. C. Meigs, 1852–60.
Capt. H. W. Benham, 1860.
Lt. J. St. Clair Morton, 1860–61.
Gen. M. C. Meigs, 1861–62.

Under Department of the Interior—
W. R. Hutton, 1862–63.
S. Seymour, 1863–65.
T. B. Samo, 1865–67.

Under War Department—

Maj. N. Michler (Bvt. Brig. Gen.). **R., 67,** 548; **68,** 904; **69,** 502, 515 (history of imp.); **70,** 522; **71,** 974.

Maj. G. H. Elliot. **R., 71,** 948.

Maj. O. E. Babcock. **R., 72,** 1019; (Col.) **73,** 1162; **74,** ii, 397; **75,** ii, 814; **76,** ii, 691; **77,** ii, 1061, 1071, 1093 (letters of Gen. M. C. Meigs concerning criticism of Rock Creek Br., and of Boards of Engineers, and of Lt. Col. Casey).

Lt. Col. T. L. Casey. **R., 77,** ii, 1089; **78,** ii, 1350; **79,** ii, 1885; **80,** 2344, 2357 (imp. of water supply; letter to Senate); **81,** 2703; **82,** 2729.

Maj. G. J. Lydecker. **R., 83,** 2077; **84,** 2299; **85,** 2453; **86,** 2013; **87,** 2527; **88,** 2749.

Lt. Col. J. M. Wilson. **R., 89,** 2809.

Lt. Col. G. H. Elliot. **R., 90,** 3501; **91,** 3875; **92,** 3349; (Col.) **93,** 4275; **94,** 3193; **95,** 4119 (list of mains laid in the District).

Maj. J. G. D. Knight. **R., 95,** 4101.

Capt. D. D. Gaillard. **R., 96,** 3905; **97,** 3991; **98,** 3642 (ex. of aqueduct tunnel).

Col. T. A. Bingham. **R., 98,** 3625.

Lt. Col. A. M. Miller. **R., 99,** 3781; **00,** 5193; **01,** 3651; **02,** 2691; **03,** 2485; (Col.) **04,** 3883.

Lt. Col. S. S. Leach. **R., 05,** 2609.

Capt. Spencer Cosby. **R., 06,** 2087; **07,** 2283; (Maj.) **08,** 2353.

Maj. J. J. Morrow. **R., 09,** 2305.

Capt. W. T. Hannum. **R., 10,** 2627.

Lt. Col. W. C. Langfitt. **R., 11,** 2935; **12,** 3457.

Assistants:

T. T Samo. **R., 68,** 907; **69,** 508; **70,** 524; **71,** 955; **80,** 2350.

Capt. T. W. Symons. **R., 85,** 2456.

LEGISLATION.

Laws relating to the aqueduct. **71,** 956.

MISCELLANEOUS.

Each an. report, principally in later years, covers the condition of the reservoirs, conduits, brs., and mains, the consumption and waste of water, the condition of the water during the year, and the daily gauge pressures.

PROJECTS.

Risk of interrupting supply of water by accident to conduit (50 years old) and recom. for constr. of another. **05,** 735.

WATER SUPPLY.

1900–01. Extravagant use of water a serious menace to supply of water with its "present" capacity (76,000,000 gallons), and at the rate of increase the ultimate limit would be reached in about 12 years. Tables given, showing consumption by day, month, etc. **01,** 3651–3665; **02,** 2696–2705 **03,** 2490–2498; **04,** 3886–3889; **05,** 2610; **07,** 2283; **08,** 2354; **09,** 2313; **10,** 2632.

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[1] Reapp. from unexpended balance of app. of $90,000, act of Congress Mar. 2, 1907. Expended under Washington Aqueduct for parking grounds, McMillan Park Reservoir.

1901-02. Est. daily per capita consumption and waste, 205 gallons; 100 gallons is ample for all domestic, business, and public uses. **02,** 593, 2697.

1902-03. Per capita consumption, 212 gallons. **03,** 655. 235 gallons. **04,** 3387. 207 gallons. **06,** 2092. 179 gallons. **09,** 2313.

1905-06. **R.** by Mr. Allen Hazen, consulting engr. on capacity of plant. Use of water, and restrictive measures to prevent waste. **06,** 2093.

1907-08. Recom. in regard to metering Federal buildings and institutions to stop waste of water. **08,** 1879.

Table showing loss of head and elevation water will assume for varying rates of flow. **09,** 2310.

Table, tons of suspended matter entering system. **09,** 2312; **11,** 2939; **12,** 3460.

R. by Lt. Hannum on condition of conduit. **09,** 2308.

Consumption and waste of water: Tables showing the average consumption of water per 24 hours, by years from 1874 to 1906 and by months from July, 1899, to Jan., 1903, will be found in the Annual Report of the Chief of Engineers for 1906, page 2092, and by months for the period Jan., 1903, to June, 1910, in the Annual Report of the Chief of Engineers for 1910, page 2632. The following table covers the fiscal years 1910, 1911, and 1912, and the accompanying diagram gives a graphic comparison with the consumption for previous years since 1899:

Table showing average consumption of water for 24 hours.

[In million gallons.]

	Fiscal years.		
	1910	1911	1912
July	64.05	64.22	66.17
Aug	61.42	62.82	63.82
Sept	60.32	62.59	60.64
Oct	59.18	61.05	59.23
Nov	55.25	57.91	56.25
Dec	56.77	62.77	53.59
Jan	62.49	60.67	71.65
Feb	60.28	57.18	70.98
Mar	56.04	53.99	60.32
Apr	58.32	55.76	57.91
May	57.76	63.04	61.25
June	58.37	62.18	61.63
Average	59.19	60.38	61.95
Average per capita consumption	173	173	175

Per capita consumption for 1912 is based on a population of 354,019, which is that assumed by the health department, D. C.

The max. daily amount of water pumped to the filters during the year was 92,720,000 gallons.

Plate showing consumption and waste. **06,** 2093; **07,** 2286; **08,** 2356; **09,** 2313; **10,** 2632; **11,** 2940; **12,** 3460.

MISC. 74. D. C. — WATER SUPPLY — WASHINGTON AQUEDUCT—LINING OF TUNNEL.

NOTE.—The total l. of unlined tunnel of the aqueduct through r. is 4,364′, and there were places in 1912 where the r. was disintegrating and falling from the sides and roofs. "Those places should be lined both for the sake of the stability of the aqueduct and to remove the danger to the lives of the employees engaged in cleaning and inspection."

By act of Congress approv. Mar. 2, 1911, the sum of $8,000 was app. for the purpose of commencing the work.

Est. of $12,000 submitted in 1912 for its continuance during the fiscal year 1914.

The actual work of lining can be done only when conditions permit the draining of the aqueduct. **12,** 1313, 3462.

APPROPRIATIONS.

See above.

ENGINEERS.

Chief of Engineers. **R.,** **11,** 1095; **12,** 1313.

In charge. Lt. Col. W. C. Langfitt. **R.,** **11,** 2941; **12,** 3462.

Assistants:

Capt. W. T. Hannum. **11,** 1094; **12,** 1311.

1st Lt. J. J. Bain. **12,** 1311.

OPERATIONS.

1911-12. During the fiscal year a concrete wasteweir was built and a sluice gate installed. About 140 c. y. of r. blasted from bottom of the tunnel, and 161 linear f. of 15-inch draintile was laid, surrounded by concrete; 186 linear f. of the invert of the concrete lining and 45 linear f. of arch was built. Besides the work done in the tunnel, a landing was built to receive materials at the side of the Chesapeake & Ohio Canal, a derrick was erected, a concrete mixer was purchased and installed, a collapsible steel form for use in building the lining was purchased, and considerable sand and gravel are now on hand to continue the work in 1913. **12,** 1313, 3462.

MISC. 75. D. C. — WATER SUPPLY — FILTRATION PLANT (INCLUDING OPERATION AND MAINTENANCE), 1900-1912.

(See Misc. 73-83 on p. 2040 of this index.)

APPROPRIATIONS.

The following data is from 12, 3480:

June 6, 1900		$200,000.00
Mar. 1, 1901		500,000.00
July 1, 1902		600,250.00
Mar. 3, 1903		600,000.00
Apr. 27, 1904		1,568,155.00
June 27, 1906		80,000.00
Mar. 2, 1907		90,000.00
May 26, 1908		82,000.00
Mar. 3, 1909		82,000.00
May 18, 1910		82,000.00
Mar. 2, 1911		91,000.00
Total		3,975,405.00
Reverted to Treasury	$44,166.63	
Reapp. under head of parking	[1] 6,000.00	
Outstanding liabilities, June 30, 1912	12,341.62	
		62,508.25
Net amount expended		3,912,896.75
(a) For constr		3,378,845.99
For mainten. and operation		534,050.76
(b) Paid by U. S		1,956,448.375
Paid by D. C		1,956,448.375

CONTRACTS.

Abstract of contracts in force. 03, 2510; 05, 2618; 06, 2101; 07, 2290.

1907. Ward W. Griffith, coal, $3.75 t. 08, 2372.

1909. Merchants Coal Co., bituminous coal. 10, 2646.

ENGINEERS.

Chief of Engineers. R., 86, 365; 98, 545; 00, 709; 01, 674; 02, 596; 03, 657; 04, 728; 05, 736; 06, 819, 2096; 07, 838; 08, 882; 09, 927; 10, 1036; 11, 1098; 12, 1316.

In charge:

Maj. G. J. Lydecker. R., 86, 2021.

Col. G. H. Elliot. R., 94, 3203; 98, 3650.

Lt. Col. A. M. Miller. R., 00, 5224; 01, 3680; 02, 2712; 03, 2505; 04, 3890.

Lt. Col. S. S. Leach. R., 05, 2609.

Capt. Spencer Cosby. R. 06, 2096, 2101; (maj.), 07, 2289, 2291; 08, 2361, 2362.

Maj. J. J. Morrow. R., 09, 2316, 2317.

Capt. W. T. Hannum. 10, 2634.

Lt. Col. W. C. Langfitt. 11, 2946; 12, 3468.

Board.

Convened by order Sec. of War. R. on proper site for filtration beds for water supply. Recom. site at est. cost $2,402,042.54. Lt. Col. A. M. Miller. Capt. L. H. Beach, Capt. D. D. Gaillard, 1st Lt. G. M. Hoffman. 01, 3683.

Assistants:

Capt. T. W. Symons. R., 86, 2021.

Capt. D. D. Gaillard. R., 98, 3640.

MAPS.

Sketch of Washington Aqueduct filtration plant. 04, 3890.

OPERATIONS.

1900-01. Preparation of drawing, erection of plant, other preliminary work. 01, 3682.

1901-02. Excavations for reservoir made and 274 l. f. east wall built; drawings for gatehouse made; excavation of intake foundation; survey of land; other misc. work. 02, 596. Amount and cost of work. 02, 2715.

1902-03. Various contracts let; excavation work begun; survey party laying out lines; temporary office established; amount and cost of work. 03, 2505.

1903-04. Filtration gatehouse completed; Michigan Ave. extension completed; installation and delivery of boilers, pumps, meters, sluice gates, and valves; cement; 18,917.1 c. y. concrete placed. 04, 3889.

1904-05. Pumping station completed; controller house completed; work on shelter house; various contract work done; 95,008 c. y. filter sand and 23,011 c. y. gravel placed. 05, 736, 2614.

1905-06. Office and laboratory, regulator houses, and shelter house completed; 5,000 sq. y. sod laid; 3,000′ gravel road built; 7,000′ cobblest. gutters laid; other misc. work done under contract. 06, 2096. Force organized for operation and mainten.; daily determinations for alkalinity and hardness made; other misc. work. Summary of total costs for operation; cost per million gallons filtered. 06, 2108; 07, 2291; 08, 2362; 09, 2317; 10, 2640.

1906-07. Only minor work done. Plant practically completed. 07, 2289.

See 1905-6.

1907-08. Machine shop erected; addl. filter unit built; gratings for covering wells in regulator houses completed. 08, 2361.

See 1905-6.

1908-09. Experimental filter plant for rate studies built. 09, 2316.

See 1905-6.

SPECIAL REPORTS.

R. by Lt. Col. Miller on treatment of Potomac R. water prior to filtration. Tables showing (1) record of filter A, (2) condition of water at Great Falls; various ests. for installing plant. 03, 2511-2515.

Remarks by Mr. Allen Hazen regarding use of a coagulant. 06, 2099.

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[1] Unexpended balance of app. of $90,000, act of Congress Mar. 2, 1907, reapp. for parking grounds, McMillan Park Reservoir, and expended under head of "Washington Aqueduct."

TABLES.

Turbidities. **06,** 2104; **07,** 2291; **08,** 2362; **09,** 2317; **10,** 2635; **11,** 2947; **12,** 3468.

Bacteria per c. c. **06,** 2106; **07,** 2292; **09,** 2319; **10,** 2636; **11,** 2948; **12,** 3470.

Summary of results of tests for bacillus coli. **06,** 2106; **07,** 2292; **08,** 2362; **09,** 2320; **10,** 2637; **12,** 3472.

Summary of sanitary chemical analyses of weekly samples. **06,** 2109.

Tables showing rate of deaths from typhoid fever. **06,** 2110; **07,** 2294.

Experimental studies on rates of filtration. **09,** 2325; **10,** 2643; **11,** 2950; **12,** 3468.

PROJECTS.

Act Mar. 1, 1901, Congress decided that the slow-sand system should be adopted; all plans were adapted to this system, and an addl. purchase of land was made, being enough to serve for a slow-sand filtration plant with a capacity of 75,000,000 gallons per diem. **01,** 3682.

Mr. Allen Hazen employed as consulting engineer. **02,** 596.

Est. for remodeling Georgetown Reservoir, and constr. works to provide for the pre. treatment of Potomac water by means of a coagulant, $90,000. **08,** 883.

MISC. 76. D. C.—WATER SUPPLY—48-INCH MAIN.

NOTE.—Act Mar. 2, 1889, au. a 48″ main from distributing reservoir above Georgetown, e. to Rock Creek at M St., thence along M St. to New Hampshire Ave., etc., to connect with an existing 48″ main from the "new" reservoir at R and Fourth Sts.; all to be done under the direction of the Chief of Engineers.

Plans, etc., begun at once. Contracts let.

In addition to line specified by Congress, a 30″ main laid from New Jersey Ave. and B to E. Capitol and Eleventh Sts.

Completed, 1891. **89,** 379, 2920; **92,** 416.

APPROPRIATION.

Mar. 2, 1889, $575,000.

ENGINEERS.

Chief of Engineers. **R., 89,** 378; **90,** 346: **91,** 441; **92,** 416.

In charge:

Lt. Col. J. M. Wilson. **R., 89,** 2828.

Lt. Col. G. H. Elliot. **R., 90** 3522; **91,** 3897; **92,** 3390.

MISC. 77. D. C.—WATER SUPPLY—INCREASING.

(See Misc. 73–83 on p. 2040 of this index.)

APPROPRIATIONS.

July 15, 1882,	$1,485,279.30
July 7, 1884,	87,500.00
Mar. 3, 1885,	87,500.00
Mar. 26, 1886,	5,000.00
Aug. 4, 1886,	555,000.00
Mar. 30, 1888,	355,000.00, **88,** 311.
Mar. 2, 1895,	[1] 125,000.00, **95,** 487.
Mar. 3, 1897,	200,000.00
June 30, 1898,	594,421.00
June 6, 1900,	139,034.34
1901,	162,222.97, **01,** 3671.
1902,	69,490.00, **03,** 656, 2501.
1908,	[2] 10,000.00, **09,** 925; **12,** 1314.
1911,	[3] 3,000.00, **12,** 1314.
Total,	3,878,447.61

CONTRACTS.

Bricks; st.; cement; pumping plant; gates, valves, etc. **01,** 3671.

Pumping plant and roof. **02,** 2708.

Fence around reservoir. **03,** 2501.

ENGINEERS.

Chief of Engineers. **R., 83,** 338; **84,** 343; **85,** 373; **86,** 366; **87,** 334; **88,** 310; **89,** 378; **90,** 348; **91,** 442; **92,** 416; **93,** 478; **94,** 434; **95,** 487; **96,** 433; **97,** 540; **98,** 545; **99,** 629; **00,** 707; **01,** 673; **02,** 594; **03,** 656; **04,** 727; **09,** 925; **10,** 1039; **11,** 1097; **12,** 1314.

Boards:

Convened by S. O. 107, July 15, 1885, to consider proj. of Maj. Lydecker for diversion of 3 small streams across the reservoir site. **R., 85,** 2497. (Col. T. L. Casey, Lt. Col. W. P. Craighill, Maj. G. J. Lydecker.)

Board for consideration of a tunnel for aqueduct extension. **R., 87,** 2546. (Col. J. C. Duane, Lt. Col. H. L. Abbot, Lt. Col. C. B. Comstock, Lt. Col. W. McFarland.)

Commission of Experts on tunnel constr. **R., 96,** 3932. (Maj. W. L. Marshall; Capt. J. L. Lusk; A. Fteley, C. E.; D. Fitzgerald, C. E.; Capt. D. D. Gaillard.)

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[1] Raising dam at Great Falls. [2] Pre. survey, etc. **10,** 1039. [3] Ex. of availability of Patuxent R., Md.

In charge:

Maj. G. J. Lydecker. **R., 83,** 2090; **84,** 2301; **85,** 2469; **86,** 2043; **87,** 2535; **88,** 2755.

Lt. Col. J. M. Wilson. **R., 89,** 2817.

Lt. Col. G. H. Elliot. **R., 90,** 3531; (Col.) **91;** 2904; **92,** 3380; **93,** 4309; **94,** 3222.

Maj. J. G. D. Knight. **R., 95,** 4111; **96,** 3950 (on feasibility and propriety of completing the tunnel conduit), 3944 (views on abandonment of incomplete aqueduct tunnel).

Capt. D. D. Gaillard. **R., 96,** 3925; **96,** 3029 (testing tunnel conduit, and on feasibility and propriety of completing the conduit); **97,** 4018.

Capt. T. A. Bingham. **R., 98,** 3658.

Lt. Col. A. M. Miller. **R., 99,** 3797; **00,** 5208, **01,** 3666; **02,** 2706; **03,** 2499; (Col.) **04,** 3889.

Maj. J. J. Morrow. **R.** (H. D. 347, 61st, 2d), **10,** 2649. (Suggests Patuxent R. as source of supply.)

Capt. W. T. Hannum. **R., 10,** 1039.

Lt. Col. W. C. Langfitt. **R., 11,** 2935; **12,** 1314,

Assistants:

Capt. T. W. Symons. **R., 85,** 2478.

Lt. C. McD. Townsend. **R., 87,** 2557; **88,** 2764, **89,** 2820.

T. B. Main and A. J. Sparrow. **R., 96,** 2942 (ex. of tunnel).

Gen. M. C. Meigs. **R.** (views on proposed abandonment of aqueduct tunnel), **96,** 3949.

R. S. Smead. **R., 00,** 5217 (tunnel).

Lt. G. M. Hoffman. **R., 00,** 5224 (reservoir air shafts).

Capt. Hoxie. **R., 85,** 2085 (ex., extension of aqueduct).

Lt. G. M. Hoffman. **R., 01,** 3671.

R. C. Smead. **R., 01,** 3674.

OPERATIONS.

1900–01. The tunnel completed from w. shaft to Howard University Reservoir. **01,** 674, 3666. Amount and cost of work. **01,** 3676.

1901–02. On Jan. 8, 1902, all connections bet. the tunnel, the reservoirs, and the city mains opened and new works placed in service. Details of work and cost. **02,** 2706, 2711.

1902–03. Work increasing water supply entirely completed, except the building of an iron fence around the reservoir. **03,** 2500. Details of work and cost. **03,** 2502, 2505.

1903–04. Entirely completed. **04,** 3889.

1909–12. See Engineers and Appropriations. An addl. increase needed. **09,** 925; **10,** 1039; **11,** 097: **12,** 1314.

SURVEYS.

Act May 26, 1908, app. $20,000 (see Appropriations) for pre. investigations and surveys for increasing the water supply. Result, with recom. of Maj. J. J. Morrow, submitted through Chief of Engineers, July 8, 1909. Reference made in the report to using Patuxent R. (Unless there be prompt installation of meters in the D. C. a new aqueduct will be necessary. Believed for the best interests of the U. S. to determine as soon as practicable the adaptability of the Patuxent R. as a source of supply.) **10,** 1039, and H. D. 347, 61st, 2d.

MISC. 78. D. C. — WATER SUPPLY — INVESTIGATION OF FILTRATION METHODS.

NOTE.—Acts June 30, 1898, and Mar. 3, 1899, called for detailed ests. of the cost of filtering the water supply of Washington, D. C.

Data relating to filtration in U. S. and foreign countries collected.

Two experimental filters erected, to test merits of English or slow system and American rapid system of filtration.

Various experiments conducted relating to turbidities, bacteriology, etc. **99,** 631, 3809.

Better results obtained from the American system of filtration. Report submitted Mar. 28, 1900. S. D. 259, 56th, 1st. **00,** 709.

APPROPRIATIONS.

1898,	$3,000	**99,** 3809; **00,** 5224.
1899,	5,000	
Total,	8,000	

ENGINEERS.

Chief of Engineers. R., 99, 631; **00,** 709.

In charge. Capt. A. M. Miller. **R.** (Lt. Col.), **99,** 3808; **00,** 5224.

OPERATIONS.

See note above.

MISC. 79. D. C. — WATER SUPPLY — METERING WATER SUPPLY OF UNITED STATES BUILDINGS AND GROUNDS.

The necessity for the prompt installation of meters is explained in the report on "Increasing the water supply of the D. C.," H. D. 347, 61st, 2d. The finding in this report that a new aqueduct was not necessary was based on the assumption, among others, that metering of all services in the D. C. would be immediately provided for.

. . . "a study of the consumption of water in the D. C. in its relation to air temperatures has led the officer in charge to conclude that the necessity for the general and complete installation of meters is still very urgent, not only to remove the necessity of an expend. of $5,000,000 or $6,000,000 for the constr. of a new aqueduct, but also to remove the possibility of the consumption of water exceeding the max. capacity of the aqueduct, which is still likely to happen in the case of the recurrence of a period of cold weather similar to that of the winter of 1904-5."

By act of Congress approv. May 18, 1910, the sum of $7,000 was app. to begin the work of metering the U. S. buildings, reservations, and grounds during the fiscal year 1911. This provided for "The purchase, installation, and mainten. of water meters to be placed on water services of the Government Printing Office, the U. S. navy yard, and the Municipal Building of the D. C., said meters to be purchased, installed, maintained, and remain under the observation and control of the officer in charge of the Washington Aqueduct."

The work provided for by the above act was completed.

10, 1038; **11**, 1098; **12**, 1315.

MISC. 80. D. C. — WATER SUPPLY — PRELIMINARY TREATMENT PLANT.

The necessity for this work is discussed in the Annual Report of the Chief of Engineers for 1908, pages 2365 to 2372.

By act of Congress, approv. May 18, 1910, provision was made for the constr. of works for applying a coagulant to the water supply and for the purchase of a coagulant.

The building for storing the coagulant was erected, the pumps, piping, dissolving tanks, heating plant, and other necessary apparatus for applying the coagulant were installed and a supply of sulphate of alumina was purchased. Coagulant was applied to the water on 10.4 days in January and 3.7 in February. **08**, 2365, 2372; **10**, 1037.

1911. The operation of this plant is now provided for in the same item of the D. C. app. act as for the operation and mainten. of the filtration plant.

11, 1100.

MISC. 81. D. C.—RESERVOIRS—DALECARLIA RECEIVING RESERVOIR.

(See Misc. 73–83 on p. 2040 of this index.)

Note.—This reservoir, completed in 1859, partly in Montgomery Co., Md., and partly in the D. C., was constr. for the storage of Potomac water from Great Falls. It became contaminated by the water flowing into it from its watershed of about 4,000 acres.

The object of the imp., begun in 1893, was the diversion from the reservoir of the contaminating water, entering the reservoir by 3 streams, East Creek, Mill Creek, and Little Falls Branch.

The proj. for the imp. provided for the erection of dams across the valleys of all these streams, and diverting the damned waters through a shaft finally and tunnel to the Potomac. Est., $150,000.

Map of watershed and plans of the works. **93**, 4308-4309.

Work was begun July, 1893. **95**, 489.

The work was completed under Col. Elliot, Nov. 15, 1895, with the exception of the acquirement of a small piece of land, about ½ acre.

The works as completed consist of 4,869′ of open paved chans., 4 earthen dams aggregating 629′, a shaft 51′ d., and 2 tunnels with an aggregate l. of 1,400′.

Water was turned into the reservoir July 27, 1895. **96**, 437, 3971.

APPROPRIATIONS.

1893, $60,000, **93**, 478, 4303.
1894, 52,500, **95**, 490, 4128.
1895, 37,500, **95**, 490, 4128.
1907, 30,000 (dr.), **08**, 880.
16,000 (dr.), **08**, 880.
20,000 (riprapping), **08**, 881.

Total, 216,000

CONTRACTS.

1907. Wetherill Bros. Machine Co., dr., $26,400. **08**, 880, 2359.

DREDGE.

Description. **08**, 2359.

ENGINEERS.

Chief of Engineers. R., 95, 489; **96**, 436. (See also Misc. 73–83 on p. 2040 of this index.)

In charge:

Col. G. H. Elliot. **R., 95**, 4121.
Maj. C. E. L. B. Davis, 1895.
Capt. D. D. Gaillard. **R., 96**, 3971.
(See also Misc. 73–83 on p. 2040 of this index.)

OPERATIONS.

1907–08. 46,380 c. y. dr. **08**, 881. Riprapping of by conduit completed, 1907. **08**, 881. About 3,806 c. y. r. quarried, and 6,886 l. f. of shore line graded, etc. **08**, 881.

1908–09. 64,210 c. y. dr. **09**, 925. 2,234 c. y. st. quarried, and 4,230 l. f. slope paved for width of 18′. **09**, 926.

RIGHT OF WAY.

2 R. R. (extension of Baltimore & Ohio R. R.), under au. of Congress, laid extensions through grounds. **93**, 4288; **09**, 926; **10**, 1039; **11**, 1097.

MISC. 82. D. C. — WATER SUPPLY — REMODELING GEORGETOWN RESERVOIR.

The necessity for the work was discussed in the Annual Report of the Chief of Engineers for 1908, pages 2365 to 2372.

By act of Congress, approv. Mar. 2, 1911, the sum of $50,000 was app. for remodeling the Georgetown Reservoir in order to continue the works for pre. treatment of the water supply. By act June 26, 1912, $58,000 was app. for completing this work.

"The sediment in the raw water will, by pre. treatment of the water, be precipitated and settle out in the Georgetown Reservoir."

During the year 1911-12 contracts were made with William F. Cush for excavation, building dam and concrete stop plank opening, and with R. E. Boiseau for constr. concrete drains, and considerable work was done by hired labor.

11, 1101; **12**, 1317.

MISC. 83. D. C. — RESERVOIRS — PARKING GROUNDS, M'MILLAN PARK RESERVOIR.

This reservoir, situated near the Soldiers' Home, has a capacity of 300,000,000 gallons. The park has an area of 118 acres. Plans were drawn by Olmsted Bros. for attractively parking this whole area.

The act of Congress providing for the expenses of the government of the D. C., approv. May 26, 1908, au. the expend. of not exceeding $6,000 for parking the grounds at the Washington City Reservoir, the funds to be available until the close of the fiscal year 1909. The work performed during that year is described at page 2327 of the Annual Report of the Chief of Engineers for 1909.

The sum of $2,000 app. by act May 18, 1910, for continuing the proj., was expended on that part of the park s. of the reservoir. 700 c. y. of soil were purchased, 424 sq. y. concrete sidewalk were laid, and 249 trees were set out.

The sum of $2,000 app. by act Mar. 2, 1911, for continuing the proj., was also expended on the area s. of the reservoir. The area was covered with soil and seeded to grass, and 559 sq. y. of sidewalk, 265 l. f. of tile drains, and 484 l. f. of concrete gutters were laid, and 1 flight of concrete steps was constr.

By act of Congress, approv. June 26, 1912, $2,000 was app. for continuing the parking in the fiscal year 1913.

In order to complete this work it will be necessary to do several thousand yards of grading on the n. and w. sides of the reservoir, to lay 13,950 sq. y. of concrete sidewalk, place 9,460 sq. y. of macadam surface on the roads, purchase 14,125 c. y. of soil for preparing the ground for planting shrubs and trees, purchase and set out 1,208 trees and 18,400 shrubs, and make other minor changes.

08, 882; **09**, 929; **10**, 1038; **11**, 1101; **12**, 1317.

MISC. 84. D. C.—WHARVES, ETC.—U. S. WHARF PROPERTY, WASHINGTON, D. C. (1900-1913).

(See Misc. 65 on p. 2072 of this index.)

1900-01. Act of Congress approv. Mar. 3, 1899, placed "wharf property and certain public spaces" in the D. C. under control and jurisdiction of the Chief of Engineers. Legal steps taken to secure possession of occupied wharf property. **01,** 3727; **02,** 2746.

App. made to pay owners for their wharf structures, etc.; leases approv. **03,** 2571.

Sea wall should be rebuilt. **04,** 3958; **05,** 2662; **06,** 2152.

Various leases in force for use of wharf. **07,** 2345; **08,** 2417; **09,** 2368; **10,** 2680; **11,** 2967; **12,** 3509.

MISC. 85. EXPLORATIONS AND RECONNOISSANCES (1867-1900).

(See Misc. 85-96 on p. 2040 of this index.)

ENGINEERS.

Chief of Engineers. **R., 67,** 53; **68,** 76; **69,** 67; **70,** 87; **71,** 103; **72,** 100; **73,** 114; **74,** 123; **75,** 131; **76,** 120; **77,** 128; **78,** 146; **79,** 188; **80,** 246; **81,** 339; **82,** 327; **83,** 342; **84,** 347; **85,** 376; **86,** 372; **87,** 344; **88,** 316; **89,** 386; **90,** 354; **91,** 449; **92,** 242; **93,** 488; **94,** 443; **95,** 497; **96,** 442; **97,** 547; **98,** 552; **99,** 639; **00,** 718.

MISC. 86. EXPLORATIONS, RECONNOISSANCES, AND WORK IN THE FIELD (1901-1912).

(See Misc. 85-96 on p. 2040 of this index.)

ENGINEERS.

Chief of Engineers. **01,** 683; **02,** 605; **03,** 668.

In charge:

Department of the Columbia—

Lt. Col. W. P. Richards, 7th U. S. Infantry. **01,** 683, 3799.

Maj. W. C. Langfitt. **03,** 668, 2915.

Department of the East—

Capt. C. A. F. Flagler. **01,** 683, 3062.

Capt. F. R. Shunk. **02,** 606.

Lt. Col. W. R. Livermore. **03,** 668, 2902.

Manila, P. I.—

Lt. Lytle Brown. **01,** 683.

Lt. C. E. L. B. Davis. **02,** 606, 3050; **03,** 668, 2903.

Department of California—

Lt. Jas. F. McKinley, 11th U. S. Cavalry. **01,** 684.

Lt. Col. David P. Heap. **02,** 606, 3050; **03,** 668, 2899.

Department of the Missouri.

Maj. Smith S. Leach. **02,** 606, 3060; **03,** 668, 2914.

Department of Texas—

Capt. C. S. Riche. **02,** 606, 3061.

Department of Colorado—

Lt. Hugh A. Drum. **03,** 668, 2916.

Lt. Burton J. Mitchell, 12th U. S. Infantry. **02,** 606, 3063.

OPERATIONS.

Engr. officers and acting engr. officers on staffs of commanding generals of military divisions and departments engaged in building and repairing roads and brs., surveys in the field, making and distributing maps, and other duties incidental to work of engrs. in the field. **01,** 683, 3799; **02,** 605, 3049; **03,** 667, 2899.

MISC. 87. EXPLORATIONS, ETC. — FORTIETH PARALLEL—GEOLOGICAL EXPLORATIONS.

ENGINEERS.

Chief of Engineers. **R., 67,** 54, 866; **68,** 76; **69,** 68; **70,** 87; **71,** 103; **72,** 101; **73,** 113; **74,** 122; **75,** 129; **76,** 119; **77,** 127; **78,** 141; **79,** 186; **80,** 245; **81,** 338.

In charge:

Clarence King, geologist. **R., 71,** 1027, 1030; **73,** 1203; **74,** ii, 477; **75,** ii, 919; **76,** iii, 217; **77,** ii, 1207; **78,** iii, 1419.

Ex. of so-called diamond fields. **73,** 1208.

MISC. 88. IRRIGATION — [(a) CALIFORNIA; (b) ARID LANDS—RECLAMATION].

(a) Irrigation—Joaquin, Tulare, and Sacramento Valleys, Cal.

ENGINEERS.

Chief of Engineers. **R., 73,** 115; **74,** 126.

Commission:

Lt. Col. Alexander; Maj. Mendell; Prof. Davidson of the Coast Survey. **H. Ex. D. 290, 43d, 1st.**

(b) Arid Lands—Fund for Reclamation of.

NOTE.—Act June 17, 1902, set apart as a fund for the reclamation of arid lands the moneys received from the sale of public lands in certain of the States and Territories.

Total amount accumulated in the fund to January, 1911, est. at almost $70,000,000. On June 30, 1910, the net investment in reclamation works amounted to $53,781,302.88, in addition to about $836,000 for secondary projs., townsite development, Indian irrigation, and general expenses.

Reclamation act requires return to the reclamation fund of the est. cost of constr.; entrymen, etc., receiving water from such projs., required to contribute their proportion. Total cash returns to June 30, 1910, $902,822.25; from water-right operation and mainten., $249,637.19. An addl. revenue of $2,086,173.73 derived from sale of town lots, water, power, etc.

June 30, 1910, U. S. prepared to supply water to 876,684 acres of land. Area of lands included in the projs. "now" (1910) under constr. over 3,100,000 acres.

The additions to the reclamation fund from the sales of public land found insufficient for the completion of the 30 primary projs. with such expedition as the necessities of settlers, etc., called for. President Taft recom. issuance of certificates of indebtedness against the reclamation fund.

Act June 25, 1910, which au. issuance of not exceeding $20,000,000 of certificates of indebtedness, made the app. subject to the conditions that it should be expended upon existing projs., etc., and that no part of the same should be expended until after the projs. had been ex. and reported upon by a Board of Army Engineer Officers, and approv. by the President.

Exs. made by the BE., and recoms. made as to the allotments of the proceeds of the certificates to be issued.

The BE., in addition, recom. allotments of that part of the reclamation fund derived from the sale of public lands to supplement the $20,000,000 loan, and to carry on worthy projs. not participating in the distribution of the loan.

BE. derived its facts from officers of the Reclamation Service, etc., settlers, landowners, and others. Feasibility of projs. considered from engineering and economic view.

BE. pointed out the importance of legislation au. sale of surplus water, and modifications of conditions for payments on certain projs. "which will otherwise fail of returning their cost to the reclamation fund."

Report of the BE. approv. by the President.

ENGINEERS.

Board:

Lt. Col. J. Biddle, Lt. Col. W. C. Langfitt, Maj. Wm. W. Harts, Maj. C. W. Kutz, Maj. H. Burgess. **R., H. D. 1262, 61st, 3d.**

Contents: Letter of transmittal, etc. Salt R. proj., Ariz. Yuma proj., Ariz.-Cal. Orland proj., Cal. Grand Valley proj., Colo. Uncompahgre proj., Colo. Minidoka proj., Idaho. Boise proj., Idaho. Garden City proj., Kans. Huntley proj., Mont. Milk R. proj., Mont. Sun R. proj., Mont. Lower Yellowstone proj., Mont. and N. Dak. North Platte proj., Wyo.-Neb. Truckee-Carson proj., Nev. Carlsbad proj., N. Mex. Hondo proj., N. Mex. Rio Grande proj., N. Mex.-Tex. Missouri R. pumping units, N. Dak. Umatilla proj., Oreg. Klamath proj., Oreg.-Cal. Belle Fourche proj., S. Dak. Strawberry Valley proj., Utah. Okanogan proj., Wash. Yakima proj., Wash. Shoshone proj., Wyo.

MISC. 89. EXPLORATIONS, ETC. — LAVA BEDS (MODOC CAMPAIGN), OREG.—RECONNOISSANCE.

ENGINEERS.

Chief of Engineers. **R., 73,** 114.

In charge: Capt. G. J. Lydecker. **R., 73,** 1219.

MISC. 90. MAUMEE VALLEY — HISTORIC GROUNDS, LOCATIONS, AND MILITARY WORKS (Examination of).

ENGINEERS.

Chief of Engineers. **R., 89,** 386.

In charge: Col. O. M. Poe. **R., 89,** 2869.

MISC. 91. MILITARY MAPS, GEOLOGICAL MAPS, ETC.

The operations of the Corps of Engineers require quite frequently the preparation of maps, plans, sketches, etc. A large number of these are printed as a part of the reports of the Chief of Engineers. (See pp. 21 of this index.) Each abstract throughout this index cites references to the maps, etc., relating to the work referred to in the abstract.

Various maps, etc., have been prepared by the department, but have not been published as a part of the reports. For example, see "Surveys—Northern and Northwest Lakes—Charts," on p. 2120-2124 of this index. The references below relate to other instances:

Maps—Military, geographical, and lake survey—

ENGINEERS.

Chief of Engineers. **R., 66,** ii, 20; **68,** 77; **69,** 69; **76,** iii, 117, 564; **77,** 125; **78,** 140; **79,** 184; **80,** 244; **81,** 337; **82,** 325.

Maps—Military and geographical—

ENGINEERS.

Chief of Engineers. **R., 83,** 341; **84,** 345; **85,** 375; **86,** 371; **88,** 316; **89,** 385.

Maps—Military and other maps—

ENGINEERS.

Chief of Engineers. **R., 90,** 353; **91,** 449; **92,** 422; **93,** 488; **94,** 443.

Maps—Campaigns and battlefields—

ENGINEERS.

Chief of Engineers. **R., 66,** ii, 23; **67,** 54; **68,** 78; **69,** 69; **70,** 88; **71,** 104; **72,** 102; **73,** 112; **74,** 121; **75,** 128; **77,** 125; **78,** 140; **79,** 185; **90,** 354.

In charge:

Maj. N. Michler (Bvt. Brig. Gen.). **R., 68,** 1199 649.: **69,**

Maj. G. L. Gillespie (Bvt. Lt. Col.). **R., 73,** 1202; **74,** ii, 476.

Lt. Col. G. K. Warren. **R., 79,** iii, 1973.

Explorations—Reports and maps, certain omissions—

ENGINEERS.

Chief of Engineers. **R., 72,** 102; **75,** 131.

In charge:

Col. J. H. Simpson. **R., 72,** 1173.

Maj. G. K. Warren (Bvt. Maj. Gen.). **R., 75,** 1240.

Maps—Inclusive of war maps—

Paragraph 393 of the Army Regulations requires that the commanding officer of each post where there are fixed batteries bearing upon a chan. will call upon the Engineer Department for accurate charts showing the soundings to the extent of the ranges of the guns. Ests. for this work submitted an. Amount usually required, $5,000. **01,** 685; **02,** 611; **03,** 673; **04,** 739; **05,** 747; **06,** 828; **07,** 858; **08,** 898; **09,** 945; **10,** 1056.

Atlas of the Battlefield of Antietam, prepared under direction of Antietam Battlefield Board. **05,** 747.

Map of battlefield of San Juan, near Santiago Cuba, printed. **06,** 828.

Maps of Manchurian campaign of Russo-Japanese War, and of the Civil War printed. **08,** 898.

In view of the urgent necessity of printing certain important military maps being prepared in addition to the prosecution of the work ordinarily accomplished under this app., the est. submitted for the fiscal year ending June 30, 1913, increased to $10,000. **11,** 30; **12,** 28.

MISC. 92. EXPLORATIONS — ONE HUNDREDTH MERIDIAN.

Territory s. of Central Pacific R. R., embracing parts of e. Nevada and Arizona.

(Topographical and geographical surveys and explorations w. of the one hundredth meridian.)

List of publications. 78, iii, 1656.

ENGINEERS.

Chief of Engineers. **R.**, 71, 101, 103; 73, 113; 74, 122; 75, 130; 76, 120; 77, 120, 127; 78, 142; 79, 186; 80, 245; 81, 338; 82, 326; 83, 341; 84, 346; 85, 376.

In charge:

Lt. G. M. Wheeler. **R.**, 73, 1211, 1217; 74, ii, 480, 589 (plan of publication of the report); 75, ii, 921; 76, iii, 219; 77, ii, 1209; 78, iii, 1421; (Capt.) 1977; 80, iii, 2459; 84, 2375.

Lt. M. M. Macomb, 4th Inf. **R.**, 81, 2806; 82, 2821; 83, 2379.

Assistants:

Lt. R. L. Hoxie. **R.**, 74, ii, 481; 75, ii, 957.

Lt. W. L. Marshall. **R.**, 74, ii, 483; 75, ii, 957, 967 (meteorology and hypsometry); 76, iii, 300, 370 (meteorology and hypsometry).

Acting Asst. Surg. H. C. Yarrow, U. S. Army. **R.**, 74, ii, 583 (natural history); 75, ii, 1059; 76, iii, 532 (ethnological research); 78, iii, 1623 (fishes), 1628 (reptiles and batrachians).

Prof. E. D. Cope. **R.**, 74, ii, 591 (geology—paleontology): 75, ii, 921, 981, 1086.

Lt. P. M. Price. **R.**, 75, ii, 960.

Lt. R. Birnie, jr., 13th Inf. **R.**, 75, ii, 961, 1098 (ruins); 76, iii, 350; 77, 1262; 78, iii, 1544; 79, iii, 2215.

Lt. S. E. Blunt, Ord. Corps. **R.**, 75, ii, 963.

Lt. C. W. Whipple, 3d Art. **R.**, 75, ii, 964; 76, iii, 367.

Dr. O. Leow. **R.**, 75, ii, 1017 (geology and mineralogy); 76, iii, 393 (geology and mineralogy); 75, ii, 1049 (agricultural researches); 76, iii, 434 (agricultural researches), 422; 75, ii, 1094 (ruins); 76, iii, 372 (meteorological conditions, Mohave Desert), 393 (geology—mineralogy); 76, iii, 408 (alkaline lakes, springs, etc.), 434 (physical and agricultural features of Mohave Desert); 76, iii, 541 (ethnology); 76, iii, 442 (vegetation of Mohave Desert), 548 (effects of dry climate).

Dr. J. T. Rothrock, acting assistant surgeon, U. S. Army. **R.**, 75, ii, 1037 (natural history and botany); 76, iii, 422 (natural history and botany).

H. W. Henshaw. **R.**, 75, ii, 1069, 1073 (ornithology); 76, iii, 444 (ornithology), 525 (mammals); 77, ii, 1303 (mammals); 77, iii, 525 (mammals); 78, iii, 1607 (mammals), 1609 (fishes), 1623, 1628 (reptiles and batrachians); 79, iii, 2260 (reptiles and batrachians).

C. E. Aiken. **R.**, 75, ii, 1070 (zoology).

A. S. Gatchet. **R.**, 75, ii, 1100 (Indian languages); 76, iii, 550.

Lt. E. Bergland. **R.**, 76, iii, 329; 77, ii, 1250; 78, iii, 1525.

Lt. W. L. Carpenter, 9th Inf. **R.**, 76, iii, 346; 76, iii, 521 (insect fauna).

Lt. C. C. Morrison, 6th Cav. **R.**, 76, iii, 356 77, ii, 1273; 78, iii, 1553.

Prof. J. Morcou. **R.**, 76, iii, 378 (geology); 78, iii, 1648 (discoveries of California).

A. R. Conkling. **R.**, 76, iii, 419 (geology); 77, ii, 1285, 1295, 1298 (geology); 78, iii, 1589, 1606 (geology).

S. H. Scudder. **R.**, 76, iii, 498 (orthoptera).

J. L. Le Conte, M. D. **R.**, 76, iii, 516 (coleoptera).

Lt. S. E: Tillman. **R.**, 77, ii, 1253; 78, iii, 1529; 79, iii, 2187.

Lt. T. W. Symons. **R.**, 77, ii, 1257; 78, iii, 1535; 79, iii, 2192.

Lt. M. M. Macomb, 4th Art. **R.**, 77, ii, 1278; 78, iii, 1561; 79, iii, 2231.

J. A. Church. **R.**, 77, ii, 1284 (Comstock Lode); 78, iii, 1567.

P. R. Uhler. **R.**, 77, ii, 1322 (hemeptera).

Lt. W. Young. **R.**, 78, iii, 1542; 79, iii, 2206; 79, iii, 2213 (survey of Great Salt Lake).

Prof. D. S. Jordan. **R.**, 78, iii, 1609 (fishes).

Lt. E. Griffin. **R.**, 79, iii, 2201.

Lt. H. H. Ludlow, 3d Art. **R.**, 79, iii, 2239.

Prof. T. H. Safford, Ph. D. **R.**, 79, iii, 2242 (astronomy).

J. H. Clark. **R.**, 79, iii, 2243 (astronomy).

M. Rock. **R.**, 79, iii, 2246 (astronomy).

Prof. J. J. Stevenson. **R.**, 79, iii, 2249, 2259 (geological report).

MISC. 93. STONES, BUILDING—EXPERIMENTAL TESTS.

ENGINEERS.

Chief of Engineers. **R.**, 74, 128.

In charge. Lt. Col. Q. A. Gillmore (Bvt. Maj. Gen.). **R.**, 75, ii, 819.

MISC. 94. MINING—SUTRO TUNNEL.

NOTE.—Act Apr. 4, 1871, the President au. and requested to appoint a board of 3, 2 members to be of the Corps of Engineers, and 1 a civil or mining engineer, to ex. and report on the Sutro Tunnel, Nev., au. by act July 25, 1866, "with special reference to the importance, feasibility, cost, and time required to constr. the same; the value of the bullion extracted from the mines on the Comstock lode; their present and probable future production; also, the geological and practical value of said tunnel as an exploring work, and its general bearing upon our mining and other national interests in ascertaining the practicability of deep mining."

ENGINEERS.

Chief of Engineers. **R., 71,** 105; **72,** 102.

Commission. **R., 72,** 1126. (Lt. Col. H. G. Wright (Bvt. Maj. Gen.); Lt. Col. J. C. Foster (Bvt. Maj. Gen.); W. Newcomb, civil and mining engineer; secretary, Capt. W. R. King.)

MISC. 95. EXPLORATIONS — UINTAH MOUNTAINS, UTAH.

ENGINEERS.

Chief of Engineers. **R., 72,** 101.

In charge. Capt. W. A. Jones. **R., 72,** 1108.

MISC. 96. EXPLORATIONS—RAYMOND EXPLORATION, YUKON RIVER, ALASKA.

ENGINEERS.

Chief of Engineers. **R., 71,** 103.

In charge. Capt. C. W. Raymond, 1871. **Ex. D.** 12, 42d, 1st.

NOTE.—This is believed to be the first exploration of the upper reaches of the Yukon.

MISC. 97. FORTIFICATIONS.

(See p. 1793 of this index.)

MISC. 98. FORTIFICATIONS—ISTHMIAN CANAL.

The constr. of these works was under the Isthmian Canal Commission, but plans for the various defensive works were prepared by the Chief of Engineers. **12,** 23.

MISC. 99. LAWS AFFECTING THE CORPS OF ENGINEERS.

NOTE.—Since 1873 the an. reports of the Chief of Engineers reprint all the laws passed in the preceding fiscal year which have a bearing on rivers and harbors, etc. See also page 2329 of this index.

Complete copies of the laws relating to rivers and harbors only are printed in several volumes, covering the laws from Aug. 11, 1790, to Mar. 4, 1913, as H. D. 1491, 62d, 3d.

1873, 121; **75,** 139; **76,** 129; **77,** 143; **78,** 163; **79,** 209; **80,** 265; **81,** 367; **82,** 353; **83,** 367; **84,** 371; **85,** 401; **86,** 395; **87,** 371; **88,** 2821; **89,** 413; **90,** 3607; **91,** 477; **92,** 3463; **93,** 519; **94,** 3455; **95,** 4259; **96,** 4079; **97,** 4137 (compilation of laws for protection of navigable waters), 4151, 4197; **98,** 3789; **99,** 3903; **00,** 5457; **01,** 3837; **02,** 3079; **03,** 2943; **04,** 4223, 4314; **05,** 2847; **06,** 2281; **07,** 2477; **08,** 2563; **09,** 2527; **10,** 2751; **11,** 3051; **12,** 3569.

MISC. 100. MONUMENTS—FORT RECOVERY, OHIO.

APPROPRIATION.

1910, $25,000, **11,** 1121.

CONTRACT.

1912. Van Amringe Granite Co., Boston, Mass. **12,** 1346.

ENGINEERS.

Chief of Engineers. **R., 11,** 1121; **12,** 1345.

In charge. Maj. J. C. Oakes. **11,** 1121; **12,** 1345.

PROJECTS.

1911. Preparatory work; designs to be submitted August, 1911. **11,** 1121.

1912. The design of monument selected is the Egyptian obelisk; it will be 101′ 4″ in h. above grade and will have at the base of the shaft and in a standing position a granite statue of a frontiersman 9′ in h. The exterior walls of the shaft will be of granite blocks and the backing of reinforced concrete, with a circular shaft in the center.

During the year the foundation and the lower 18 courses of the shaft were completed. **12,** 1345.

MISC. 101. MONUMENTS—FREDERICK THE GREAT.

APPROPRIATION.

1904, $8,000, **04,** 4199.

ENGINEERS.

Chief of Engineers. **R., 04,** 742; **05,** 749.

In charge. Capt. J. S. Sewell. **R., 04,** 4199; **05,** 2835.

PROJECTS AND OPERATIONS.

1904. The work was au. by the sundry civil act Apr. 28, 1904.

* * * * *

"To defray the expenses incident to the erection and dedication, upon War College grounds, Washington Barracks, of the statue of Frederick the Great, the gift to the United States of His Imperial Majesty the Emperor of Germany, to be immediately available, eight thousand dollars."

Contract awarded for the granite pedestal; contractors had selected rough blocks for the work by the close of the fiscal year. Some study given subject of a suitable order of exercises for the dedication of the statue. **04,** 4199.

1905. Pedestal purchased and placed in position, the statue placed thereon, unveiling ceremonies on Nov. 19, 1904.

Pedestal stands on the line of front steps leading up to the terrace in front of the War College. It occupies one of six granite bases provided for similar purposes.

All the work in connection with the statue proper has been completed, except that an inscription stating the date of dedication remains to be placed on the s. side of the base of the pedestal. **05,** 2835.

MISC. 102. MONUMENTS—TO GENS. FRANCIS NASH AND WM. LEE DAVIDSON.

CONTRACTS.

1905. James F. Nowlan, monuments, $8,750. **05,** 2837. Henry Bonnard Bronze Co., New York, 4 bronze tablets, $500. **05,** 2837.

ENGINEERS.

Chief of Engineers. **R., 03,** 676; **04,** 742; **05,** 750; **06,** 830.

In charge:

Capt. E. E. Winslow. **R., 03,** 2939.

Capt. R. P. Johnston. **R., 04,** 4201; **05,** 2837; **06,** 2273.

PROJECTS.

Congress au. $5,000 by joint resolution, Jan. 30, 1903, for each monument. **03,** 676.

Sites in Guilford battle grounds, near Greensboro, N. C., selected by governor of North Carolina. approv. by Sec. of War. **03,** 2939.

Resolution of Continental Congress, Nov. 4, 1777. Resolved, That his excellency Governor Caswell of North Carolina be requested to erect a monument of the value of $500, at the expense of the U. S., in honor of the memory of "Brig. Gen. Francis Nash, who fell in the Battle of Germantown, on the 4th day of October, 1777, bravely contending for the independence of his country."

Resolution of Continental Congress, Sept. 20, 1781. Resolved, That the governor and council of the State of North Carolina be desired to erect a monument, at the expense of the U. S., not exceeding the value of $500, to the memory of the "late Brig. Gen. Davidson, who commanded the militia of the district of Salisbury, in the State of North Carolina, and was killed on the 1st day of February last, fighting gallantly in the defense of the liberty and independence of these States."

To carry those resolutions into effect, Congress, by joint resolution, approv. Jan. 30, 1903, app.

$5,000 for each monument, the funds to be disbursed under the direction of the Sec. of War.

The monuments completed, 1906, and given into the custody of the State of North Carolina, to be "cared for and preserved by the State."

The monuments, which are practically identical in design, are simple monumental arches, with two bronze inscription tablets on each monument, but with no sculpture. These arches span a narrow roadway in the Guilford battle ground, which crosses the Atlantic & Yadkin R. R., a branch of the Southern R. R., at the battle-ground station, about 6 m. from Greensboro, N. C. The road crosses the R. R. approx. at right angles, and the arches are on either side of the R. R. and about equidistant therefrom.

The monuments are 33′ 6¾″ h., 28′ 6″ w., and 7′ thick, and present a very massive, substantial appearance. The clear w. of archway is 12′ 6″ and the clear h. from the ground to the soffit of the keystone is 20′ 4¼″. The arches are of solid granite masonry, the exposed sts. being cut to true dimensions, but with quarry faces, and the interior or core being of rubble. The outside or exposed sts. vary from 8″ to 18″ in thickness, so that core and shell are intimately bonded together. The granite has a uniform light-gray color (almost white) and is very even grained and almost entirely free from stains or flaws of any kind.

On the front face of each monument (that is, the face toward the R. R.) the surname of the officer to whom the monument is erected appears in large raised letters on the heavy belt st. immediately above the keystone.

The inscription tablets are of cast bronze, each tablet being 2′ 6″ in w. by 3′ 6″ in h. These tablets are placed on the front faces of the columns supporting the arch, and are at such height from the ground as to be conveniently and easily read.

The inscriptions read as follows:

Inscriptions on tablets on Davidson Monument:

Tablet No. 1—Brigadier General William Lee Davidson. Born 1746. Killed in the battle of Cowan's Ford, N. C., February 1st, 1781. Major, April 15, 1776. Lieut. Colonel, Oct. 4, 1777. Brigadier General, Aug. 31, 1780. "On Fame's eternal camping ground."

Tablet No. 2—"To the memory of the late Brigadier General Davidson, who commanded the militia of the District of Salisbury, in the State of North Carolina, and was killed on the 1st day of February last, fighting gallantly in defence of the liberty and independence of the States." (Extract from Resolution of Congress September 20, 1781.)

Inscriptions on tablets on Nash Monument:

Tablet No. 1—Brigadier General Francis Nash. Born 1742. Fatally wounded in battle of Germantown, Pa., October 4, 1777. Member of Provincial Congress of North Carolina, 1775. Lieutenant Colonel, September 1, 1775. Colonel, April 10, 1776. Brigadier General, February 5, 1777. "Ever since the dawn of the Revolution I have stood for the cause of Liberty and my country."

Tablet No. 2—"In honor of the memory of Brigadier General Francis Nash, who fell in the battle of Germantown, on the 4th day of October, 1777, bravely contending for the independence of his country." (Extract from Resolution of Continental Congress November 4, 1777.)

06, 2273.

MISC. 103. MONUMENTS—GUILFORD COURTHOUSE.

APPROPRIATION.

1911, $30,000, **11**, 1122.

CONTRACTS.

See Projects.

ENGINEERS.

Chief of Engineers. R., **11**, 1122; **12**, 1348.

In charge:

Capt. E. I. Brown. **11**, 1122.
Capt. L. H. Rand. **12**, 1348.
Maj. H. W. Stickle. **12**, 1348.

PROJECTS.

Act Feb. 13, 1911, aut. erection of a monument on the battle field of Guilford Courthouse, Guilford County, N. C., to commemorate the battle fought there on Mar. 15, 1781, by the American forces, commanded by Maj. Gen. Nathanael Greene, and in memory of Maj. Gen. Nathanael Greene and the officers and sailors of the Continental Army who participated in the Battle of Guilford Courthouse. The funds to be expended under the direction of Sec. of War.

Operations during 1910–11 consisted in the preparation of a program of competition, the selection of a location for the monument, and the acceptance of a deed to the site selected. **11**, 1122.

Of the various models, selection made of No. 5; award made to the designer, Mr. Packer; price, $27,500. **12**, 1348.

MISC. 104. MONUMENTS—KINGS MOUNTAIN, S. C.

APPROPRIATION.

1906, $30,000, **07**, 861.

CONTRACT.

1908. Southern Marble & Granite Co., monumental constr., $25,000 (supplemental contract, $21,000). **09**, 2521.

ENGINEERS.

Chief of Engineers. **R.**, **07**, 861; **08**, 903; **09**, 950; **10**, 1060.

In charge:

Capt. G. P. Howell. **07**, 861.
Capt. E. P. Stuart. **R.**, **08**, 2561.
Capt. E. I. Brown. **R.**, **09**, 2521.
Capt. E. N. Adams. **R.**, **10**, 2745.

PROJECTS AND OPERATIONS.

1907. Act June 16, 1906, au. erection of a monument on Kings Mountain battle ground to commemorate the victory of the War of the American Revolution, Oct. 7, 1780. Title to the land determined by the Attorney General of the U. S., to rest with the Kings Mountain Centennial Association of S. C. **07**, 861.

1908. Recom. and approv. that McKim, Mead & White, architects, New York City, be employed to prepare designs and specifications for this monument. The type of monument decided upon an obelisk bearing 4 tablets, for inscriptions, within an inclosure.

Bids opened Apr. 23, 1908, for the constr. of this monument, and contract was awarded to The Southern Marble & Granite Co., Spartanburg, S. C., to construct a monument 115′ 3″ h., of granite from the quarry of The North Carolina Granite Corp., Mount Airy, N. C., for the sum of $25,000.

At the close of the fiscal year the plan of the monument had been approv., the inscriptions for the bronze tablets had received the approval of the Sec. of War, and everything was in readiness for the constr. of the monument; the contractor had built storage sheds and office on the site, and ground had been broken for the excavation for the foundation on June 23. **08**, 2561.

1910. Owing to the greater d. required to secure a suitable footing for the foundation, it became necessary to reduce the size of the monument originally contemplated. Supplemental contract was therefore made for the constr. of a monument 83′ 6″ h., with lightning conductor installed, for the sum of $21,000. Under this contract the monument completed, with the exception of the sculptured work, setting of the bronze tablets, and erection of inclosure. During the year this work was completed and final payment under the contract was made. **10**, 2745.

MISC. 105. MONUMENTS—MONTEREY, CAL.

APPROPRIATION.

1907, $10,000, **09**, 2523.

ENGINEERS.

Chief of Engineers. **R.**, **08**, 903; **09**, 951; **10**, 1061.

In charge. Lt. Col. J. Biddle. **08**, 903; **R.**, **09**, 2523; **10**, 2749.

PROJECTS AND OPERATIONS.

During the War with Mexico, on July 7, 1846, Commodore Sloat, in accordance with instructions from our Government, landed a force of sailors and marines at Monterey and took possession of California in the name of the U. S. In 1886 an organization composed of Mexican War veterans, California pioneers, Army and Navy officers, and others prominent in the affairs of the State, was formed for the purpose of erecting a monument to Commodore Sloat, the organization being known as the Sloat Monument Association.

A site was procured on the military reservation of the Presidio of Monterey, on the slope of a hill overlooking the B. of Monterey. Upon this site, which is unobstructed by trees or adjacent buildings, a suitable foundation was laid and a base, or platform, for the proposed monument was constr., faced with sts. which were contributed by various counties of the State, military, and civic organizations. The base is 24′ sq. and 6′ h.

The U. S., act Mar. 4, 1907, app. $10,000 for the erection of a monument to Commodore John Drake Sloat, U. S. Navy, at Monterey, Cal. A portion of this sum, not to exceed $1,000, to be devoted to procuring a suitable design and other pre. expenses, leaving about $9,000 for the actual work, act of Mar. 28, 1908.

The amount expended on base unknown.

With the aid of the San Francisco Art Institute and the Sloat Monument Association, a design made; approv. by Sec. of War June 29, 1909.

Competitive designs obtained by offering 3 prizes of $250, $150, and $100, respectively. **08**, 903; **09**, 951, 2523.

1910. Monument completed June 2, 1910, and dedicated June 14, 1910. **10**, 2749.

MISC. 106. MONUMENTS—NEW ORLEANS, LA.

APPROPRIATION.

1907, $25,000, **07, 862.**

CONTRACT.

1908. M. P. Doullert, building work (3 contracts). **08, 2560.**

ENGINEERS.

Chief of Engineers. **R., 07, 862; 08, 902; 09, 949.**

In charge:

Capt. J. F. McIndoe. **07, 862; R., 08, 2559.**
1st Lt. W. Willing. **09, 949.**
Lt. Col. L. H. Beach. **R., 09, 2519.**

PROJECTS AND OPERATIONS.

Act Mar. 4, 1907, Congress au. completion of a monument to memory of the soldiers who fell in the Battle of New Orleans in the War of 1812. Design of the monument approv. by Sec. of War May 17, 1907; work of constr. and disbursement of funds assigned to Engineer Department. The site of the structure is at Chalmette, La. **07, 862.**

The Chalmette monument was originally designed by Newton Richards, whose plans were accepted by the Jackson Monument Association in May, 1855. This design consisted of a plain shaft 142′ h., resting on 5 steps, each 2′ h. and starting about 2′ 6″ above the natural surface of the ground; the shaft to be 16′ 8″ sq. at the base and 12′ 6″ at the top; the base of the shaft to have on the 4 faces corniced projections surmounted with sculptured emblems, one of these to serve as an entrance to a spiral stairway leading to a chamber at the top; the stair to be lighted by small openings at regular intervals; both shaft and base to be faced with marble.

A contract for the erection of the monument was awarded in June, 1855, but the work was not completed.

At the time Congress made the above app. no work had been done for over 50 years, it is said. The shaft was 56′ 10″ h., measuring from the top of the mound of earth about 12′ 6″ above the natural surface and about 185′ in diameter which had been placed around the monument to protect the brick foundation. The base was 16′ 8″ sq. outside and 10′ 8″ diameter inside; the top was 14′ 11″ sq. outside and 9′ 11″ diameter inside.

Under proj. approv. July 6, 1907, it was proposed to remove the mound of earth covering the base of the existing monument, to extend the shaft on the original lines 24′ 2¼″, and to place thereon a pyramid 9′ h., making the top of the monument when completed approx. 100′ above the natural level of the ground. The entire shaft and base are to be covered with marble. A spiral stairway, with iron steps supported by a central brick pier and the brick lining of shaft, leads to an observation chamber 9′ 6″ sq. in top of monument. There is to be a bronze door at the entrance to the monument, bronze handrails on both sides of stairway, bronze grilles in the windows of observation chamber, and a bronze historical tablet on the wall of observation chamber. **08, 902.**

The monument was completed by the contractor in December, 1908, and in March, 1909, transferred to the custody of the United [States] Daughters of 1776 and 1812, as required by the act of Mar. 4, 1907, under au. of a letter from the Sec. of War dated Mar. 5, 1909. **09, 949.**

MISC. 107. MONUMENTS—POINT PLEASANT.

CONTRACT.

(See Projects, etc.)

ENGINEERS.

Chief of Engineers. **R., 09, 952; 10, 1061.**

In charge:

Capt. F. W. Altstaetter. **09, 2525; 10, 2747.**

PROJECT AND OPERATION.

The public building act May 30, 1908, appr. the sum of $10,000 to aid in the erection and completion of a memorial structure at Pt. Pleasant, W. Va., to commemorate a battle of the Revolution fought at that point.

1909. The site and plans having been approv. by the Sec. of War for the erection of a granite monument in Tu-endi-wei Park, Pt. Pleasant, W. Va., contract entered into bet. the U. S., the trustees of the Pt. Pleasant battle monument, and the Van Amringe Granite Co., of Boston, for the erection of a monument at a cost of $15,000, $10,000 of which, less cost of supervision, is to be paid by the Government. **09, 952, 2525.**

1910. The lower courses, shaft, bronze tablets, and the "Frontiersman" statue were placed. On July 22, a storm wrecked the cribbing used in erecting the monument, but no damage was done to the permanent work. The monument was accepted on the part of the Governemnt Nov. 26, it having been unveiled by the people of Pt. Pleasant on Oct. 9. **10, 2747.**

MISC. 108. MONUMENTS—TO SERGEANT FLOYD.

ENGINEERS.

Chief of Engineers. R., 99, 641; 00, 722; 01, 687.

In charge. Capt. H. M. Chittenden. R., 00, 5455; 01, 3827.

Deficiency act Mar. 3, 1899, app. $5,000 for erection, in cooperation with Floyd Memorial Association, of a monument near Sioux City, Iowa, over the remains of Sergt. Charles Floyd, of the Lewis and Clark[1] Expedition. This sum expended in conjunction with other sums app. by Iowa, county of Woodbury, Iowa; city of Sioux City, Iowa; and contributions from various other sources, the total amounting to nearly $20,000. Work conducted entirely under supervision of the U. S. Engineer office in Sioux City.

At the close of 1900 the foundation for the monument had been completed, a contract had been let on the part of the State of Iowa for the st. in the shaft, and advertisements were out for the erection of the monument, this part of the work to be done from the U. S. app.

The monument was formally dedicated May 30, 1900.

The foundation is a solid monolith of concrete, approx. of the form of a frustum of a pyramid, with 484 sq. f. bearing surface. It weighs 278 t.

The style of the shaft is that of the Egyptian obelisk. The base is 9.42′ sq. and the h. is 100.174′. The material is cut st. from the Kettle R. sandst. quarries of Minnesota. The cut st. comprises the greater part of the volume of the shaft, there being a small core composed of concrete. Upon the e. and w. faces of the shaft are 2 large bronze tablets[2] with suitable inscriptions. The monument is protected from defacement by a steel picket fence 7½′ h. A concrete pavement in the form of a terrace and roadway extends around the monument to the circumference of a circle of nearly 50′ radius. The grounds in the immediate vicinity have been graded, and a roadway has been constructed from the monument to the nearest public highway.

The monument and 1 acre of ground around it are now the property of the Floyd Memorial Association. 01, 687.

Calculation for constr. of obelisk. Constr. of foundation. Securing dimension st. Proportions of Bunker Hill, Bennington, and Washington Obelisks. 01, 3827.

MISC. 109. MONUMENTS—BRIG. GEN. SHIELDS.

APPROPRIATION.

1910, $3,000, 10, 1062.

CONTRACTS.

(See Projects.)

ENGINEER.

Chief of Engineers. R., 10, 1062; 11, 1120.

In charge. Maj. E. H. Schulz. 10, 1062; 11, 1120.

PROJECTS.

Act June 25, 1910, au. monument over grave of Brig. Gen. James Shields, St. Marys Cemetery, Carrollton, Mo. 10, 1062.

Award was made to Jerome Connor, sculptor, of Washington, D. C., $2,925. Monument completed and accepted Nov. 12, 1910. Unveiled on this date with appropriate ceremonies in the presence of the widow and son of Gen. Shields. There were also present distinguished citizens of Carrollton, the State of Missouri, and the Nation, including Hon. H. S. Hadley, governor of Missouri; Hon. W. W. Rucker, Member of Congress from the second district of Missouri; Jerome Connor, the sculptor and contractor, of Washington, D. C.; and others. National troops from Fort Leavenworth and Missouri State troops were in attendance.

The monument was erected on the Shields lot in St. Marys Cemetery, Carrollton, Mo. It rests on a concrete foundation 6′ 8″ by 7′ 6″ by 6′ d. The pedestal is 8′ 6″ h., of 3 pieces of Missouri granite, with all the exposed surfaces highly polished, and weighs between 15 and 16 t. The first base is 6′ 8″ by 7′ 6″ by 1′, the second 4′ 8″ by 3′ 10″ by 1′ 8″, and the third 4′ 2″ by 3′ 4″ by 6′ 10″. On this is placed the bust, 4′ 6″ in height. It is of American standard bronze and weighs 800 pounds. Total height, 14′.

On the face of the monument, n. side, is engraved:

"General James Shields, born in County Tyrone, Ireland, May 10, 1810, and died in Ottumwa, Iowa,

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[1] NOTE.—The records of the expedition spell Clark's name sometimes with a final "e" and sometimes without. A facsimile of a document signed by Clark shows that he spelled his name without a final "e."

[2] Tablet on west face of monument:

"Floyd. This shaft marks the burial place of Sergeant Charles Floyd, a member of the Lewis and Clark Expedition. He died in his country's service and was buried near this spot August 20, 1804. Graves of such men are pilgrim shrines; shrines to no class or creed confined. Erected A. D. 1900, by the Floyd Memorial Association, aided by the United States and the State of Iowa."

Tablet on other faces of monument:

"In commemoration of the Louisiana purchase, made during the administration of Thomas Jefferson, third President of the United States, April 30, 1803. Of its successful exploration by the heroic members of the Lewis and Clark Expedition. Of the valor of the American soldier and of the enterprise, courage, and fortitude of the American pioneer to whom these great States west of the Mississippi River owe their secure foundation."

June 1, 1879. Soldier, jurist, statesman. Erected by the United States under an act of the Congress approved March 15, 1910."

Underneath was placed the bronze coat of arms of the U. S. On the right side the words "Winchester, Port Republic"; on the left side "Cerro Gordo, Chapultepec"; and on the rear of the pedestal is another bronze ornament, consisting of a palm leaf with the seals of the States which he represented in the U. S. Senate, with the inscription, "United States Senator from Illinois, Minnesota, and Missouri." **11**, 1120.

MISC. 110. MONUMENTS—MEMORIAL ARCH AT VALLEY FORGE.

APPROPRIATION.

1911, $100,000, **11**, 1121.

CONTRACTS.

1911. Paul P. Cret, architect, $5,460. **12**, 1346.

1912. H. L. Brown, erection, $91,000. **12**, 1347.

ENGINEERS.

Chief of Engineers. **R.**, **11**, 1121; **12**, 1346.

PROJECTS.

Act June 25, 1910, au. erection, upon site of the encampment during the winter of 1777-78, of a memorial arch within the Valley Forge Park. The said act also provided that the amount au. should be expended by the Valley Forge Park Commission under the direction of the Sec. of War; no app. made.

Act Mar. 4, 1911, made app. and provided that the money should be expended under the direction of the Sec. of War.

In 1910 resolution adopted by Valley Forge Park Commission approving the perspective drawings, plans, and specifications submitted by Mr. Paul P. Cret, architect, and directing their submission to the Sec. of War., who gave his approval Mar. 27, 1911. Location originally decided upon at a point near the intersection of the Old Gulph Road and the Outer Boulevard; approv. by Sec. of War.

During 1910-11 topographical survey of site made and test borings made to determine character of soil and d. to which foundation of arch should be carried.

At the close of the year modified drawings and specifications for the constr. of the arch were in course of preparation.

A contract was entered into with Mr. Paul P. Cret, under date of May 20, 1911, covering his services as architect for the constr. of the arch. **11**, 1121.

1912. Excavation work in progress; models and decorative work in progress; detailed drawings made. **12**, 1347.

MISC. 111. PARKS, NATIONAL—CRATER LAKE.

APPROPRIATION.

(See Project.)

1910, $10,000, **11**, 1118, 3036.

ENGINEERS.

Chief of Engineers. **R.**, **11**, 1118; **12**, 1340.

In charge. Maj. J. J. Morrow. **R.**, **11**, 3035; **12**, 3561.

PROJECT.

A complete description of Crater Lake Park is found in Professional Paper No. 3, Department of the Interior, U. S. Geological Sur., entitled "The Geology and Petrography of Crater Lake National Park," by J. S. Diller and H. B. Patton; Government Printing Office, 1902.

The sundry civil act approv. Aug. 24, 1912, provided an app. of $50,000 for expend. under the direction of the Sec. of War for the constr. of a wagon road and the necessary brs. through Crater Lake National Park, together with a system of tanks and water-supply pipes to provide for sprinkling in accordance with the recoms. contained in the **R.** published in H. D. 328, 62d, 2d, referred to below. **12**, 1341.

OPERATIONS.

1911. A sur. of the nature of a pre. R. R. sur. was made covering the road from the entranc to the park on the approach from Klamath Falls up to the crater rim at the present location of the lodge of the Crater Lake Co., and a sur. of the proposed road encircling the lake was completed with the exception of a short piece over the cliff near Andersons Spring. Measurement of discharge of all convenient springs was completed. Nearly 50 m. of pre. lines were run and platted. **11**, 3035.

1912. During the fiscal year one party, constituted as each of the parties of the preceding season, was sent into the park in July, 1911, under the direction of Junior Engr. W. G. Carroll, and finished the work uncompleted during the preceding season, namely, 6 m. of the 36 m. of road encircling the lake, the 5 m. of road to the Pinnacles, and the

4 m. of road to the e. boundary of the park. This work comprised about 1 month of field work. After the return of the field party, in the office, all transit lines were computed and platted, the location was profiled, ests. were completed, and final R. submitted Nov. 21, 1911. This R. is printed in full with map and profiles in H. D. 328, 62d, 2d. The total est. cost of the system of roads and trails is $642,000, with an addl. $65,000 for a system of tanks and sprinkling, and an an. est. after completion for mainten. of $20,000. **12, 3561.**

SURVEYS.

Act June 25, 1900, an. sur., locating and preparing plans and est. for roads and trails in Crater Lake National Park, Oreg. **11, 1118.**

MISC. 112. NATIONAL PARKS — YELLOWSTONE NATIONAL PARK—OFFICE, YELLOWSTONE PARK, WYO.

APPROPRIATIONS.

	Administration and protection.	Roads and bridges.	Total.
Mar. 3, 1883	$16,429.97	$23,570.03	$40,000.00
July 7, 1884	16,999.98	23,000.02	40,000.00
Mar. 3, 1885	16,790.63	23,209.37	40,000.00
July 15, 1886	934.25		934.25
Aug. 4, 1886		20,000.00	20,000.00
Mar. 3, 1887		20,000.00	20,000.00
Oct. 2, 1888		25,000.00	25,000.00
Mar. 2, 1889		50,000.00	50,000.00
Aug. 30, 1890		75,000.00	75,000.00
Mar. 3, 1891		75,000.00	75,000.00
Aug. 5, 1892		45,000.00	45,000.00
Mar. 3, 1893		30,000.00	30,000.00
Aug. 18, 1894		89,434.76	30,000.00
Mar. 2, 1895	10,565.24		30,000.00
June 8, 1896			5,000.00
June 11, 1896			35,000.00
June 4, 1897	6,736.74	28,263.26	35,000.00
July 7, 1898	11,356.57	28,643.43	40,000.00
Mar. 3, 1899	5,534.64	34,465.36	40,000.00
June 6, 1900	5,000.00	55,000.00	60,000.00
Mar. 3, 1901	5,000.00	113,000.00	118,000.00
June 28, 1902	5,000.00	250,000.00	255,000.00
Mar. 3, 1903	5,000.00	250,000.00	255,000.00
Apr. 28, 1904	7,500.00	250,000.00	257,500.00
Mar. 3, 1905	7,500.00	133,000.00	140,500.00
June 30, 1906	7,500.00	55,000.00	62,500.00
Mar. 4, 1907	8,000.00	75,000.00	83,000.00
May 27, 1908	10,500.00	65,000.00	75,500.00
Mar. 4, 1909	8,000.00	65,000.00	73,000.00
June 25, 1910	8,500.00	75,000.00	83,500.00
Mar. 4, 1911	8,500.00	70,000.00	78,500.00
	171,348.02	2,046,586.23	2,217,934.25
Receipts from sales		551.15	551.15
	171,348.02	2,047,137.38	2,218,485.40
Received from other sources (see money statement, 1903, p. 2892)		210.00	210.00
Received from other sources (see money statement, 1904, p. 4178)		117.80	117.80
Received from other sources (see money statement, 1905, p. 2812)		523.15	523.15
Total	171,348.02	2,047,988.33	2,219,336.35
Less amount reverted to Treasury, July, 1904, app. 1901-2		621.22	621.22
Grand total	171,348.02	2,047,367.11	2,218,715.13

12, 1338.

CONTRACTS.

1901. C. B. Scott, teams. **01**, 3783.

1903. American Br. Co., constr. material, over 500,000 pounds, 3.35¢ to 4¢ lb. Paul McCormick, teams. **03**, 2893; **04**, 4178.

ENGINEERS.

Chief of Engineers. **R.**, **87**, 342; **88**, 314; **89**, 382; **90**, 352; **91**, 477; **92**, 422; **93**, 486; **94**, 441; **99**, 637; **00**, 716; **01**, 682; **02**, 604; **03**, 666; **04**, 737; **05**, 744; **06**, 825; **07**, 856; **08**, 896; **09**, 942; **10**, 1053; **11**, 1114; **12**, 1334.

In charge:

Capt. C. B. Sears. **R.**, **87**, 3133.

Maj. C. J. Allen. **R.**, **88**, 2803; **89**, 2857.

Maj. W. A. Jones. **R.**, **90**, 3591; **91**, 3931; **92**, 3433; **93**, 4391; **94**, 3439.

Capt. H. M. Chittenden. **R.**, **99**, 3863; **00**, 5403; **01**, 2777; **02**, 3033, 3042; **03**, 2444, 2885; (Maj.) **04**, 4171; **05**, 2809.

1st Lt. E. D. Peek, 1906–8. **R.**, **06**, 2253; **07**, 2461; (Capt.) **08**, 2543.

1st Lt. A. Williams, 1908–9.

1st Lt. W. Willing, 1909–11. **R.**, **09**, 2509; (Capt.) **10**, 2735.

Capt. C. H. Knight, 1911. **R.**, **11**, 3029; **12**, 3555.

Assistants:

Lt. W. E. Craighill. **R.**, **89**, 2862; **90**, 3595; **91**, 3939.

Lt. H. M. Chittenden. **R.**, **92**, 3439; **93**, 4396.

A. E. Burns. **R.**, **00**, 5420; **01**, 3795, 3796.

C. E. Sherman. **R.**, **00**, 5417; **01**, 3789.

C. A. Hunt. **R.** (Bridges), **94**, 3447.

S. F. Crecelius. **R.**, **01**, 3793; **02**, 3046.

E. D. Vincent. **R.**, **02**, 3045.

PROJECTS.

The Yellowstone National Park was set apart from the public domain and placed under the control of the Sec. of Interior, act Mar. 1, 1872.

Sundry civil act Mar. 3, 1883, au. constr. and imp. of suitable roads and brs. under the supervision of an Engineer officer to be detailed by the Sec. of War; officer detailed 1883.

This was the beginning of systematic road constr. in the park. Previous work consisted of opening rough trails, temporary in character.

Subsequent to sundry civil act Aug. 4, 1886, expend. for imp. transferred to charge of Engineer Department.

Has since been in charge of Engineer Department, with exception of period August, 1894, to March, 1899. **12**, 1334.

By Capt. C. B. Sears, 1887, comprehensive system of substantial roads, which, with the change of the act of Mar. 3, 1891, is the basis of the system in force 1912.

Sundry civil act June 6, 1900, au. that road extension and imp. be made in harmony with general plan to be approv. by Chief of Engineers. Plan approv. Aug. 27, 1900; modified by au. Sec. of War, July 22, 1901; further modified by approv. of Chief of Engineers, July 2, 1902.

Sundry civil act June 28, 1902, recognized this proj., and provided for its completion; practically finished during June 30, 1906.

The road system comprises a belt line or main circuit, which reaches all of the important centers of interest, with side roads, bridle trails, and 4 approaches leading from the park boundary to different points on the belt line—in all, about 350 m. of road, and about 125 brs.

Existing proj., 1912, provides that the belt line and the approach from the n. entrance be thoroughly metaled with crushed r., gravel, or other good material; that iron pipe, tile, or other good material be used for culverts; that steel and concrete be used for brs.; and that roads on the main tourist route be sprinkled. Roads into the park, except from the n., are constr. and maintained as earth roads. **92**, 3450; **00**, 5441; **01**, 3786; **12**, 1335.

1901. "Est. total cost of the proj., exclusive of an. mainten. and repairs and of macadamization, is $870,000. Of this sum $472,000, in round numbers, has been expended, about $88,000 ($113,000, act Mar. 3, 1901, less $25,000 an. repairs) is available, and $310,000 is required. The cost of an. mainten. and repairs has been about $174,000.

* * * * *

"The result of the expend. thus far, after certain portions of the road are rebuilt, will be about 190 m. of road and 80 brs. constr. There remain to be built about 144 m. and 11 costly brs." **01**, 682.

Proposal of Chief of Engineers to macadamize belt line of roads approv. by Sec. of War (150 m.; est., $2,000 per m.). **01**, 3797.

1903. Plan for parking grounds, Mammoth Hot Springs. Notes on planting. By W. H. Manning. **03**, 2894.

1905. Maj. Chittenden est. $75,000 an. for mainten. **05**, 2813.

On account of the growing public interest in the park, and the consequent demand upon its roads, $2,000,000 est. for enlargement and extension of the proj. **05**, 2816.

In 1905 Maj. Chittenden, in a memorandum, outlined the peculiar needs of the road system of the park. **05**, 2816.

Recom., also, that park be made a separate Engineer district. Objection to addl. roads, as not being at all needful or desirable. **05**, 2822.

Change in route of road from Tower Falls to Mammoth Hot Springs recom. on account of dangerous slides. Observatory on Mount Washburn also recom. **06**, 2257.

1910.[1] "The apps. for the 'past' 6 years have proven inadequate for mainten., and if steps are not taken to replace old worn-out brs. terrible accidents are liable to happen. The road surface, too, is in a poor and worn-out condition and in need of a more thorough treatment than can be given with the small apps. that have been made during the past few years." **10**, 1054; **11**, 1114.

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[1] Special request for separate allotment for road repairs. H. D. 772, 61st, 2d.

1911. Steps had been taken from 1909 looking toward gradual accumulation by the department of its own animals for work in park. **11,** 3032.

1912. (See Operations, 1912.)

OPERATIONS.

1883-87. Résumé. **87,** 3133.

1872-00. Résumé. **00,** 5420.

1901. Work in Golden Gate Canyon, including reconstr. viaduct, completed; single-track road built from Golden Gate to Middle Gardiner Falls; material for brs. in Gardiner Canyon purchased and 1 abutment erected; 10 m. road opened up on the e. approach, and nearly the whole line located; extensive repairs over the whole system. **01,** 682, 3777.

The new road has been extended about 3 m. down the Yancey Hill: the sur. and definite location have been carried to the Yellowstone R. and to Tower Falls, and the 2 brs. for the Yellowstone and Lamar Rs. have been contracted for.

In the lower Gardiner Canyon 1 br. abutment has been put in, the spring rise preventing any further work until after it subsides.

On the e. approach about 6 m. of road has been graded and the br. over the Yellowstone has been about half built.

On the s. approach extensive repairs have been carried over the road from the Thumb to near Lewis R. and material has been partly assembled for the Lewis R. br.

Under general repairs and completion the road to the middle Gardiner Falls has been extended entirely around Bunsen Peak. The entire circuit of the belt line was opened before June 1, something never before accomplished in the history of the park. The Natural Br. cut-off has been built about 2 m. The whole line of road from Mammoth Hot Springs to Golden Gate has been resurfaced. A very steep hill, called Soap Hill, just below Fort Yellowstone has been cut out, replacing a 15% grade with one of 8%. The very dusty road across a portion of the Norris Geyser Basin formation has been entirely resurfaced. The Gibbon R. branch of the w. approach has been extensively imp. About 1½ m. of formation road near the Fountain Hotel have been resurfaced, and also about 2 m. of road in the Spring Creek Canyon. Besides these more important repairs the entire system has been gone over several times by small parties. **01,** 3784.

1902. In vicinity of Yanceys Road constr.; locating Mount Washington road; work in Gardiner Canyon, on East Road, South Road, Mammoth Hot Springs; general repairs and Road completion; sprinkling; Howard-Chief Joseph Trail located with aid of special party, some being participants in Nez Perce Indian campaign. **02,** 3034.

Increasing water supply, Fort Yellowstone, under allotment by Quartermaster General of $8,000 from app. for transportation of the Army. **02,** 3042.

1903. Extensive work at Mammoth Hot Springs, including reconstr. of the roads, the building of a large amount of concrete sidewalk, the grading and irrigation of the grounds, the completion of the water-supply system, the installation of an electric-light plant, and the erection of several necessary buildings.

The reconstr. of the road between Gardiner and Mammoth Hot Springs, including the partial constr. of an entrance gate at the n. boundary, corner stone being laid by President Roosevelt.

The partial constr. of a road between Mammoth Hot Springs and the Middle Gardiner.

The reconstr. and surfacing of 7 m. of road between Mammoth Hot Springs and Norris.

The reconstr. of the road in the vicinity of Virginia Cascade and at Blanding Hill.

The reconstr. of 3 stretches of road in the Gibbon Canyon for the purpose of cutting out bad hills.

The completion of about 3 m. of road on the Natural Br. Cut-off.

The grading of a new crossing of Cascade Creek at the Grand Canyon, and the surfacing with r. of about ½ m. of road in that vicinity.

The constr. of about 10 m. of new road on the Mount Washburn division.

The opening of nearly 40 m. of new road on the e. approach.

The opening of 4 m. of road, s. approach, and the completion of about 6 m. more.

The purchase and partial erection of 9 new brs., including the Melan Arch Br. over the Yellowstone.

The purchase of 12 new sprinkling wagons and the installation of the plant between Gardiner and Norris.

Extensive repairs to the entire system. Owing to the lateness of the season and the excessive amount of freight hauling in the early spring, the roads suffered very heavily, and the cost of opening them up was much greater than usual.

A new station house and barn were built for the superintendent at the s. boundary. **03,** 2885.

1904. Extensive work in the vicinity of Gardiner, including the preparation of a large field for alfalfa sowing for the use of the superintendent in protecting the game in the winter.

The resurfacing with gravel of the entire line of road between Gardiner and Mammoth Hot Springs.

Completion of road between Mammoth Hot Springs and the Middle Gardiner Br.

Continuation of reconstr. of road between Mammoth Hot Springs and Norris, about 6 m.

Completion of about 3 m. of road on Natural Br. Cut-off.

Continuation of work on both sides of Mount Washburn, a total distance of about 6 m.

Opening of e. road (July 10, 1903) to travel and the execution of a large amount of work on this road.

The erection of a steel-concrete arch br. over the Yellowstone above the Upper Falls.

The opening of a new road from this br. to Artist Pt.

The erection of a steel arch br. over Cascade Creek, near the Grand Canyon, and the completion of approaches thereto.

Erection of a steel br. over the Gibbon R., in Gibbon Canyon.

Erection of the new Baronett Br. (steel) near Yanceys.

Extension of sprinkling system so as to cover about 55 m.

Heavy repair and mainten. work extending to every part of the system.

Erection of a new station house and barn at Gardiner for the use of the superintendent.

And many other less important items of work throughout the park.

04, 4171.

1905. The erection of a 5-span steel arch br. over the Middle Gardiner R. near Mammoth Hot Springs, being the largest br. in the park.

The erection of a steel truss br. over Nez Perce Creek near the Fountain Hotel, and of another over the Firehole R. above Excelsior Geyser.

The erection of a steel arch br. over Tower Creek near the falls, and of 4 wooden brs. over Trout and Antelope Creeks in Hayden Valley and over the Big and Little Blacktail Creeks on the road between Mammoth Hot Springs and Tower Falls.

The reconstr. of wooden brs. over Gibbon R. near Norris, the Firehole R., on the old freight road near the Fountain Hotel, and over the same stream above the Upper Geyser Basin.

The erection of a large wooden br. over the Lamar R. on the road to Cooke City, and also one over Grinnell Creek on the East Road.

The erection of a curved viaduct on the road e. of Sylvan Pass for the purpose of carrying the road over itself and by means of a loop diminishing the gradient to the adopted limit.

Extensive resurfacing and reconstr. of the roads on the main circuit from near Apollinaris Spring to Norris and thence to the lower end of Gibbon Canyon, and from the Fountain Hotel to the Upper Geyser Basin, and thence to the Continental Divide; also considerable work of a similar character on the road along the Yellowstone R. between the lake and Grand Canyon.

The completion of the road between the Thumb and Lake by way of Natural Br.

Extensive reconstr. and resurfacing of the road between Norris and the Grand Canyon, including the cutting down of several of the hills and the complete realignment down the long hill next to the Grand Canyon.

The opening and completion of the road across Mount Washburn, including both the low line through Dunraven Pass and the high line passing over the summit. On the low line there still remains about ½ m. where further widening will be required.

The opening up of the entire line of road between Tower Falls and Mammoth Hot Springs, including the reconstr. and enlargement of the road from Crescent Hill Canyon to Tower Falls.

A general reconstr. of the Cooke City road from the Lamar R. crossing to Soda Butte.

The extensive enlargement of the road from the Canyon Hotel to Inspiration Pt. near the latter pt. and the completion of a new road from the new concrete-steel br. over the Yellowstone to Artist Pt. on the right bank of the Grand Canyon.

A considerable amount of imp. work on the w. approach, including widening of the road, resurfacing, and other work.

Extensive widening and enlargement of the East Road from Sylvan Pass to the Shoshone R.

General repairs and mainten. of the entire system.

The extension of the sprinkling system to include 100 m. of roadway.

The erection of 3 station houses and 11 officers' quarters at the station houses for the superintendent.

Considerable work in the imp. of the bridle trails for the use of the superintendent in patrolling the park.

Many other minor items of work pertaining to the imp. of the entire system.

05, 745.

1906. The irrigating ditches in the alfalfa field near the n. entrance of the park were kept in repair, and a new system of lateral ditches put in the field to imp. the distribution of water.

The mainten. of the lawns and shrubbery at Mammoth Hot Springs was continued throughout the season.

100 m. of the park roads were sprinkled up to Sept. 1.

A number of pumping tanks at various points on the circuit were converted into gravity tanks.

The reconstr. of the Cooke City road from the Lamar R. crossing to Soda Butte was partly completed.

The road from the concrete-steel br. across the Yellowstone R. down to Artists Pt. was widened and resurfaced.

The West Road was widened and surfaced, and mileposts put into the w. boundary.

The road between Upper Basin and De Lacy Creek was widened at a number of places and resurfaced.

The South Road between the Thumb and Jackson Lake was kept in repair.

The road over Mount Washburn was practically completed, except that there is a little over ½ m. of road on the low line that will need further widening.

The wooden brs. over the Gibbon R. near Norris, the Firehole R. on the old freight road near the Fountain Hotel, and over the same stream above the Upper Geyser Basin, were reconstr.

A 150′ wooden viaduct was built at the e. end of Sylvan Pass on the East Road.

A wooden br. was erected over Grinnell Creek, and other brs. on the East Road were repaired.

Guard rails were erected at different points of interest to protect the formation and also to protect the tourists.

The Hot Soda Spring, near Mammoth Hot Springs, and the Apollinaris Spring were cleaned out and wells constr. around them in order to keep the surroundings free from mud.

General repair and mainten. of the entire system.

Many other minor items of work pertaining to the imp. of the entire system.

06, 826.

1907. General repair and mainten. of the entire system, including the Cooke City, East, West, and South Roads; the constr. of a road to the petrified tree stumps in the vicinity of Yanceys, and the excavation of the r. surrounding one of the stumps; repairs to brs.; the replacing of Sulphur Creek Br. by a culvert and fill; laying of tile culverts; constr. at a number of points of platforms for the loading and unloading of coaches; constr. of platforms and stairways in the canyon, of outhouses at several places, and of 3 houses on the Divide for working crews; the clearing of dead and falling timber from the roadside; 100 m. of road sprinkled, a number of pumping stations converted into gravity tanks, and hydraulic rams installed; repairs to sprinkling wagons, road graders, carts, and other vehicles; the purchase of a portable planer and the dressing of lumber; mainten. of trees, shrubs, vines, and lawns; the erection of a fence at Hymen Terrace, and of an iron fountain in front of the residence of the U. S. commissioner; care of the alfalfa field at Gardiner (since transferred to the charge of the superintendent of the park); the purchase of about 600 enameled-steel signs; the survey of a road to connect the canyon and Tower Falls, and a survey, in progress, for a road from the w. boundary of the park, at the crossing of the Gallatin R., to a point on the Norris Road about 7 m. from Mammoth Hot Springs.

07, 2461.

1908. .General repair and mainten. of the entire system, including the Cooke City, East, West, and South Roads; repairs to brs.; the replacing of brs. at Alum Creek and Obsidian Creek by culverts and fills; laying of tile and iron culverts; the clearing of dead and fallen timber from the roadside; 85 m. of road sprinkled; a number of pumping stations converted into gravity tanks, and hydraulic rams installed; repairs to sprinkling wagons, road graders. carts, and other vehicles; mainten. of trees, shrubs, vines, and lawns; erection of about 500 enameled-steel signs; a survey for a road from the w. boundary of the park at the crossing of the Gallatin R. to a point on the Norris Road about 7 m. from Mammoth Hot Springs. **08**, 2543.

1909. General repair and mainten. of the entire system, including the Cooke City, East, West, and South Roads; repairs to brs.; laying of tile and iron culverts; the clearing of dead and fallen timber from the roadside; 85 m. of road sprinkled; a number of pumping stations converted into gravity tanks, and hydraulic rams installed; repairs to sprinkling wagons, road graders, carts, and other vehicles; mainten. of trees, shrubs, vines, and lawns. There was expended during the fiscal year 1909, for mainten. and repairs, $80,672.91, and on the East and South Roads of the forest reserve, $263.21. **09**, 2509.

1910. General repair and mainten. of the entire system, including the Cooke City, East, West, and South Roads; repairs to brs.; laying of tile and iron culverts; the clearing of dead and fallen timber from the roadside: 85 m. of road sprinkled; a number of pumping stations converted into gravity tanks, and hydraulic rams installed; repairs to sprinkling wagons, road graders, carts, and other vehicles; mainten. of trees, shrubs, vines. and lawns. There was expended during the fiscal year 1910, for mainten. and repairs, $47,845.45. **10**, 2735.

1911. General repair and mainten. of the entire system, including the Cooke City, East, West, and South Roads: the constr. of 5 bridges, 4 steel and 1 wooden; repairs to brs.; the constr. of 487′ of concrete retaining walls; laying of the tile and iron culverts; the clearing of dead and fallen timber from the roadside; 85 m. of road sprinkled; a number of pumping stations converted into gravity tanks, and hydraulic rams installed; repairs to sprinkling wagons, road graders, carts, and other vehicles; mainten. of trees, shrubs, vines, and lawns. There was expended during the fiscal year 1911, for mainten. and repairs, $73,874.02, and for permanent work, $15,000; a total expend. of $88,874.02. **11**, 3029.

1912. Act Mar. 4, 1911, app. $70,000 for 1912, and provided that $2,500 of it should be spent for mainten. of roads leading out of the park from e. and s. boundaries. On account of grave probability of accidents to tourists, app. applied to replacing by safe structures certain old brs., general repair and mainten. of entire system, including Cooke City, East, West, and South Roads, constr. of 3 steel brs., and a number of small wooden brs.; repairs to brs. and culverts; the clearing of dead and fallen timber from the roadside; the sprinkling of 100 m. of road; the conversion of a number of pumping stations into gravity tanks, and the installation of hydraulic rams; repairs to sprinkling wagons, road graders, carts, and other vehicles; and the mainten. of trees, shrubs, vines, and lawns. Sprinkling was continued as long as funds could be spared for the purpose and discontinued early in August, but only when the available balance remaining was reduced to an amount barely sufficient to pay the ordinary running expenses for the remainder of the fiscal year, and the cost of the new brs. contracted for and urgently needed. Immediately after sprinkling operations were stopped protests against such discontinuance were received from prominent persons, and the President called for a special report on the matter. The Engineer officer in local charge of the road work had already reported that the action was occasioned by lack of funds, and he stated, furthermore, that rains had left the road in poor condition and that the suspension of sprinkling and the limitations on other works, due to the lack of funds, was likely to result in serious damage before the end of the tourist season and to leave the roads in poor shape to meet the winter storms. By oral direction of the Sec. of War a special est. was prepared for continuing the work of sprinkling and for contingencies likely to arise before the next app. became available. The amount named was $12,000. The est. was submitted to Congress Aug. 19, 1911, and was published in H. D. No. 111, 62d, 1st, but no app. was made.

On Apr. 20, 1912, the acting superintendent of the park informed the Sec. of Interior that the main entrance road, between Fort Yellowstone at Mammoth Hot Springs and the R. R. station at Gardiner, Mont., would probably soon be closed, as the hillside was gradually slipping into the road; absolutely necessary to keep that road open for the full year, and that to have it closed then, when supplies for the summer were coming in for the park concessioners and for the military post, would be a calamity. He also stated that the dangerous part had been kept open during the autumn and winter by the labor of troops, but that an immense amount of earth must be removed before the road would be safe for travel.

On Apr. 30, 1912, the retaining wall and a portion of the road at the point in question slid into the river, leaving a passageway but 3′ in w. As the Engineer officer in charge of the road work was without means for restoring wagon communication between Fort Yellowstone and Gardiner, the acting superintendent of the park sent a detachment of 40 men from the fort and widened the passageway to 6½′. A detachment was also employed throughout the month of May in repairing the retaining wall and keeping the road cleared of r. and dirt at the point where the slide occurred.

May 15, 1912, a special supple. est. of $20,000 for emergency repairs to roads in the park was submitted to Congress. This est. was published in H. D. No. 761, 62d, 2d, but no app. was made. In May the Interior Department allotted the sum of $500 for opening the old wagon trail between Fort Yellowstone and Gardiner. The work was executed under the direction of the Engineer officer and completed on June 21.

No app. was made by Congress for the work during the fiscal year and there were no funds available in the hands of the Engineer officer for opening the roads for the tourist season of 1912. The expend. during the fiscal year for mainten. and repairs were $36,524.62 and for permanent work $22,713.88, a total expend. of $59,238.50.

In response to a Senate resolution, dated Apr. 2, 1912, directing the Sec. of War—

> "to submit to the Senate as early as possible an estimate of the cost of construction of new roads or changes in the present roads in the Yellowstone National Park in order to permit of the use of automobiles and motorcycles therein without interfering with the present mode of travel in vehicles drawn by horses or other animals—"

A R. on the subject prepared by Capt. Knight was sent to Congress with a letter of the Acting Sec. of War, dated June 26, 1912. It was printed in S. D. No. 871, 62d, 2d. The est. cost of constr. of new roads for the purpose was $2,704,030 and for reconstr. of the existing road $2,264,670. The an. cost of mainten. was placed at $187,625 in case new roads are constr., and at $112,886 if the existing roads are widened.[1] 12, 1337.

SPECIAL DATA.

Aqueducts—concrete.[2] 03, 2476.

Automobiles—dangerous in park. 03, 2468.

Bridges[2]—Gardiners R. 02, 3034. Buffalo Fork, Otter Creek, Shoshone R., Gardiners R., Snake R., The Yellowstone, Cascade Creek. 03, 2457. Constr. details. 03, 2457, 2474. Steel-concrete, over Yellowstone.[2] 03, 2473.

Camping parties. 03, 2467.

Canyons—retaining walls. 03, 2454.

Cliffs—overhanging.[2] 03, 2450.

Climate—details. 03, 2449.

Concrete arch viaduct—Golden Gate, Glen Creek Canyon.[2] 01, 3790.

Concrete work—gates and viaducts; methods.[1] 03, 2470.

Corduroy—advantageous only at point. 03, 2457.

Cross slopes—right design. 03, 2459.

Culverts—danger from there being so many needless ones. 03, 2458.

Dams—concrete dams, building. 03, 2476. Building methods, Mammoth Hot Springs. 03, 2476.

Ditches—for drainage, dangerous. 03, 2457. Water supply. 02, 3044.[2] Cross drains, objectionable. 03, 2459.

Dust.[2] 02, 3036.

East Road—view and character. 01, 2781. Forest, tangent on.[2] 03, 2452.

Fires.[2] 01, 3782; 02, 3042.

Fords—elimination of. 03, 2458.

Forests—details. 03, 2446.

Fountains—concrete. 03, 2476.

Gardiner Canyon—road.[2] 03, 2450.

Gates—entrance.[2] 03, 2469.

Irrigation—methods. 03, 2477. Fountain.[1] 02, 3044.

Landmark—removal of, Golden Gate Rock. 03, 2471.

Lumber—manufacture of. 03, 2459.

Mileage system—extent. 01, 2784.

Mount Washburn Road—view.[2] 03, 2452, 2454.

Mountain systems—details. 03, 2446.

Old Golden Gate viaduct—view.[2] 01, 3790.

Park work—system and methods. 03, 2459. Camps for. 03, 2460.

Railroads—electric lines impracticable. 03, 2468.

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[1] Sundry civil act approv. Aug. 24, 1912, provided an app. of $100,000 for the usual work of mainten. and repair of imps., including not to exceed $4,500 and $1,500 for the roads in the forest reserves leading out of the park from the e. and s. boundaries, respectively; and an additional app. of $77,000 for widening and imp. surface of roads and for building brs. and culverts, from the belt-line road to the w. border, from the Thumb Station to the s. border, and from the Lake Hotel Station to the e. border, all within the park.

[2] Photographs.

Reservoirs—concrete.[1] **03,** 2476. Dams.[1] **02,** 3044.

Retaining walls—constr. details. **03,** 2457. Gibbons Falls.[1] **03,** 2456. Gardiners R.[1] **03,** 2456. Under cliff, Tower Falls. **03,** 2456.

Roads—restriction on freight haulage. **08,** 2549. Passenger traffic, methods. **03,** 2467. Freight haulage over. **03,** 2466. Cleaning done by chipmunks. **03,** 2466. Irregular trackage difficult to stop. **03,** 2466. Wide tires obligatory. **03,** 2465. Use of oil on. **03,** 2463. Sprinkling. **03,** 2462. Opening in spring. **03,** 2461. Mainten. and repair system. **03,** 2461. Securing proper surfaces. **03,** 2458. Constr. methods. **03,** 2456. Yellowstone Lake to e. boundary, description. **01,** 2793.

Road system—general description: Main circuit or belt lines—approaches—mileage—trails. **03,** 2444. Problem to locate.[1] **03,** 2450. Gradients. **03,** 2453. Rolling roads and their supposed advantages. **03,** 2454.

Seasons of drought. **01,** 3782.

Shoshone or Stinkingwater R.—description. **01,** 2781.

Signposts—necessity for. **03,** 2459.

Side hills—Mount Washburn Road. **03,** 2452.

Snow—bad effect of on roads. **09,** 2510. Shoveling the passes. **03,** 2460.[1] Effect of forests on melting of.[1] **03,** 2446, 2449. Drifts. **03,** 2456.

Soil—character. **03,** 2448.

Sprinkling—wagon.[1] **02,** 3044.

Tower Cliffs—cliff and road.[1] **03,** 2450.

Viaduct—details, Golden Gate.[1] **03,** 2470.

Winds—high. **01,** 2791.

SURVEYS.

The act of Mar. 4, 1907, app. $1,000 for a sur. for a road from the point where the Gallatin R. crosses the w. boundary to a point on the Mammoth Hot Springs-Norris road.

The first sur. was begun on June 9, 1907, and completed July 2, 1907. This route, via the Gallatin R., Big Horn Pass, and then to Indian Creek on the Norris-Mammoth Hot Springs road, was deemed unfav., and on July 28, 1907, a second party left Bozeman and began a sur. via Gallatin R., Fan Creek, Snowshoe Pass, thence down the Gardiner and Glen Creek to Golden Gate. The second route, also, was not recom. The est. cost, distances, and recoms. are contained in a special R. submitted to the Chief of Engineers under date of Oct. 19, 1907 (H. D. 502, 60th, 1st), which also expresses the views of the superintendent of the park, who coincides with the Engineer officer in charge in not favoring any route from the Gallatin, principally for the reasons that the burden of maintaining the necessary existing roads and of properly guarding the park is now very great, and that the proposed new road would add materially to this burden without any corresponding benefit to the general public. **08,** 2546.

MAPS.

Tourist routes. **01,** 3798; **02,** 3048; **05,** 2822.

MISC. 113. RIVERS AND HARBORS[2]—UNIFORMITY RELATING TO APPROPRIATIONS.

R. dated Dec. 18, 1909, by a board of Engineers on ex. of certain Hs. on the Great Lakes and elsewhere in which the whole or a part of the H. is imp. at local expense, containing recoms. as to whether the imps. so made by local authorities should be undertaken or maintained by the General Government; also, as to uniform rules in making H. imps., required by the R. and H. act of Mar. 3, 1909, was duly submitted and reviewed by the BERH., pursuant to law. The R. was transmitted to Congress and printed in H. D. No. 1067, 61st, 3d, which contains discussions and recoms. in reference to the several questions called for by the above-mentioned act. **11,** 1073.

Act Mar. 3, 1909, au. ex. of the Hs. of the Great Lakes and elsewhere in which the whole or a part of the H. is imp. at local expense, with a view to determining whether the imps. so made by local authorities should be undertaken or maintained by the General Government and to establish uniform rules in making H. imps. R. by BE. (constituted by S. O. 20, O. C. E., Apr. 30, 1909), on Dec. 18, 1909.

Members of the board—Col. D. W. Lockwood, Col. D. C. Kingman, Col. C. McD. Townsend, Lt. Col. J. Millis, Maj. Riche.

Recoms. of the board—

1. That advisability of U. S. undertaking any work be determined as by existing practice.
2. That the U. S. undertake constr. or mainten. at no locality where such work would benefit only private interests.
3. That U. S. work be confined to the general part of a H., etc., including break'rs, with their anchorage areas; entrance piers and js. and their contiguous chans.; and general chans. of approach.

BE. recom. that imps. made by local authorities should not be undertaken or maintained by the U. S.

The above recoms. reviewed, in accordance with law, by the BERH. Concurrence in general principles of the **R.** of the BE.; but recognized "that there may be instances in which the interests of the general public will not require a rigid application of the principles stated in item 3, and that there be exceptional cases in which imps. made by local interests will fall within the class of works deemed proper for the General Government to undertake or maintain, or that will so conform to an advantageous proj. for further imp. of the locality as to merit special consideration.—H. D. 1067, 61st, 3d.

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[1] Photographs.

[2] The duty of improving rivers, harbors, and other national waterways, according to the will of Congress, devolves upon the Chief of Engineers. The abstracts of the Rs. of the latter on this duty extend from p. 17 to p. 1791 of this index. (See also pp. 2041 of this index.)

(For a brief (and memorandum) relating to the riparian and water rights of the Federal Government, and of the various States, see S. D. 351, 61st, 2d.)

MISC. 114. RIVERS AND HARBORS, ETC.—ASSISTANTS.

The **Rs.** of assistants to Engineer officers in charge of R. and H. works were printed in the **Rs.** of the Chief of Engineers up to or about 1905, after which date they were omitted generally from the an. **Rs.** on account of the growing volume of the **Rs.** After 1905 they are usually printed in the congressional documents devoted to **Rs.** on Rs. and Hs. The important reports of assistants are referred to throughout this index, usually under the subhead of "Assistants." (See p. 21 of this Index.)

MISC. 115. RIVERS AND HARBORS—BOARDS—BOARD OF ENGINEERS FOR RIVERS AND HARBORS.[1]

Chief of Engineers. R., 03, 36; **04,** 704; **05,** 712; **06,** 791; **07,** 807; **08,** 857; **09,** 898; **10,** 1008; **11,** 1065; **12,** 1279.

Section 3 of the R. and H. act of June 13, 1902, provides for the organization in the Office of the Chief of Engineers, by detail from time to time from the Corps of Engineers, of a board of 5 Engineer officers, whose duties shall be fixed by the Chief of Engineers, and to whom shall be referred for consideration and recom., in addition to any other duties assigned, so far as in the opinion of the Chief of Engineers may be necessary, all reports upon exs. and surs. provided for by Congress and all projs. or changes in projs. for works of R. and H. imp. theretofore or thereafter provided for, etc.

The board was constituted July 28, 1902, by the appointment of the following officers of the Corps of Engineers: Col. A. Mackenzie, Maj. H. F. Hodges, Maj. Edward Burr, Capt. C. H. McKinstry, and Capt. W. V. Judson.

On May 7, 1903, Col. Mackenzie was succeeded as senior member of the board by Lt. Col. Chas. J. Allen, Corps of Engineers.

Under the provisions of section 14 of the R. and H. act of June 13, 1902, all reports on pre. exs. and surs. provided for in that act referred to the board for ex. and review; in addition, the projs. for certain imps. presented to it for report, by resolution of the House Committee on Rs. and Hs., and by the Chief of Engineers. The reports rendered by the board from time to time presented to Congress at its regular sessions. **03,** 36, 637.

The report of this board on a proposed work of imp. is customarily printed as a part of the congressional document relating to the proposed work.

1903-04. Col. Chas. J. Allen, to Jan., 1904, senior member; Col. A. M. Miller, senior member, since Jan., 1904; Lt. Col. R. L. Hoxie; Maj. H. F. Hodges; Maj. E. Burr; Maj. H. C. Newcomer; Capt. C. H. McKinstry; Capt. W. V. Judson. Detailed information relative to reports reviewed by board. **04,** 3671.

1904-05. Col. A. M. Miller, senior member; Lt. Col. D. W. Lockwood; Lt. Col. R. L. Hoxie; Maj. S. W. Roessler; Maj. E. Burr; Maj. H. C. Newcomer; Capt. W. V. Judson; Capt. C. W. Kutz. Details. **05,** 2569.

1905-06. Lt. Col. D. W. Lockwood; Lt. Col. R. L. Hoxie; Lt. Col. S. W. Roessler; Maj. W. C. Langfitt; Maj. E. Burr; Maj. C. McD. Townsend; Capt. C. W. Kutz. Details. **06,** 2055.

1906-07. Col. D. W. Lockwood; Col. R. L. Hoxie; Maj. C. McD. Townsend; Maj. W. C. Langfitt; Maj. E. E. Winslow; Maj. C. Harding; Capt. C. W. Kutz; Capt. W. J. Barden. Details. **07,** 2241.

1907-08. Col. D. W. Lockwood; Col. R. L. Hoxie; Lt. Col. S. S. Leach; Lt. Col. W. L. Fisk; Lt. Col. H. F. Hodges; Maj. E. E. Winslow; Maj. C. Harding; Capt. Wm. J. Barden. Details. **08,** 2321.

1908-09. Col. D. W. Lockwood; Col. Jno. G. D. Knight; Col. R. L. Hoxie; Col. S. S. Leach; Lt. Col. W. C. Langfitt; Maj. H. C. Newcomer; Maj. E. E. Winslow; Maj. Spencer Cosby; Maj. Wm. J. Barden. Details. **09,** 2277.

1909-10. Col. D. W. Lockwood; Col. Jno. G. D. Knight; Col. Wm. T. Rossell; Col. S. S. Leach; Lt. Col. W. C. Langfitt; Lt. Col. W. E. Craighill; Lt. Col. H. C. Newcomer; Maj. Herbert Deakyne; Maj. Wm. J. Barden. Details. **10,** 2445.

1910-11. Col. Wm. T. Rossell; Col. Dan C. Kingman; Col. S. W. Roessler; Lt. Col. W. C. Langfitt; Lt. Col. H. Taylor; Lt. Col. H. C. Newcomer; Maj. H. Deakyne; Maj. W. J. Barden. Details. **11,** 2657.

1911-12. Col. W. T. Rossell; Col. S. W. Roessler; Lt. Col. W. C. Langfitt; Lt. Col. H. Taylor; Lt. Col. H. C. Newcomer; Maj. Herbert Deakyne; Maj. W. J. Barden. Details. **12,** 2879.

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[1] Proposed national waterways commission.—S. D. 301, 61st, 1st.

OPERATIONS.

Authority for investigation.	Number of investigations ordered.	Number completed during year ending June 30, 1912.	Total number completed prior to June 30, 1912.	Number remaining to be completed.
Act of June 13, 1902	170		170	
Act of Mar. 3, 1905	176		176	
Act of June 28, 1906	1		1	
Act of Mar. 2, 1907	200		200	
Act of May 28, 1908	1		1	
Act of Mar. 3, 1909	274	18	263	11
Act of June 25, 1910	187	64	169	13
Act of Feb. 27, 1911	90	67	69	21
Resolutions of congressional committees	102	5	97	5
Concurrent resolution of Congress	1	1	1	
Miscellaneous cases referred by the Chief of Engineers, U. S. Army	41	6	40	1
Total	1,243	161	1,187	56

Fiscal year.	Estimated cost of projects recommended by board.	Estimated cost of projects adopted by Congress.
1904	$904,117	$886,000
1905	8,550,000	8,550,000
1906		
1907	11,506,857	11,506,857
1908	433,000	233,000
1909	2,119,000	2,119,000
1910	1,387,030	1,387,030
1911	1,355,000	
1912	3,905,000	
Total	30,160,004	24,681,887

MISC. 116. BRIDGES — DRAWBRIDGES — APPLICATION OF RULES AND REGULATIONS.

(See p. 2137 of this index.)

MISC. 117. BRIDGES—OBSTRUCTING NAVIGATION.

(See p. 2137 of this index.)

MISC. 118. BRIDGES OVER NAVIGABLE WATERS.

Various acts of Congress, general and specific, require the approval of the War Department for br. constr. or changes over U. S. navigable waterways, and for the operation of such brs. Specific instances of such approval and over sight, reported upon by the Chief of Engineers, are indexed under the head of "Bridges." (See p. 2137 of this index.)

MISC. 119. CANALS.

Canals built or owned by the U. S. come within the embracing term of R. and H. works. Where privately built or owned canals affect other navigable waterways, they are, of course, subject to the regulatory powers of Congress.

(See the "Rivers and Harbors," p. 17 of this index. See also the "Finding List" at the back of this index for references to specific canals, including the Isthmian or "Panama Canal.")

(See also below.)

MISC. 120. CANALS — CHESAPEAKE AND DELAWARE BAYS (CANAL CONNECTING).

(See also pp. 313, 335 and 2116 of this index.)

By joint resolution of Congress approv. June 28, 1906, the President au. to appoint commission to ex. and appraise value of works and franchise of Chesapeake & Delaware Canal with reference to desirability of purchasing said canal by U. S.

Commission composed of Gen. Felix Agnus, Maj. C. A. F. Flagler, Chief of Engineers, and Civil Engineer Frank Taylor Chambers, U. S. Navy. **06,** 798.

R. Jan. 1, 1907, submitted to Congress, printed in S. D. No. 215, 59th, 2d. Works, franchises, etc., of Chesapeake & Delaware Canal appraised at $2,514,289.70. **07,** 228.

MISC. 121. CANALS—CHICAGO DRAINAGE CANAL.

In April, 1899, trustees of Sanitary District of Chicago requested permit from Sec. of War to connect drainage canal with West Fork of South Branch of Chicago R.; granted May 8, 1899.

The discharge from R. into drainage canal caused current which endangered navigation; order issued by Sec. of War, Apr. 9, 1901, reducing max. discharge to 200,000 c. f. per minute; subsequently modified to permit an increase to 300,000 c. f. per minute bet. 4 p. m. and 12 midnight, daily.

Trustees of Sanitary District undertook enlargement of waterway of Chicago R., with view to providing for full discharge required by State law without causing such current as to injure interests of navigation. **01,** 119; **02,** 580; **03,** 640.

MISC. 122. CANALS — LOCKS — BISHOP'S CANAL LOCK—EXAMINATION.

ENGINEERS.

Chief of Engineers. R., 69, 65.

Board. R., 69, 529. Maj. W. P. Craighill (Bvt. Lt. Col.); and Capt. W. R. King (Bvt. Maj.).

BE. detailed Feb. 21, 1867, to ex. and report upon a model of an imp. canal and ship lock submitted by Mr. Martin Bishop, Ohio.

Novel arrangement, gates move up and down on horizontal axes, hoisting apparatus, weight of gate counterpoised, filling and emptying of chamber by wickets, movement of wickets affected by screw system. Object of inventor to have perfect lock when the gate is up, and an open chan. when entirely submerged. New system would save weight and expense of operation.

Detailed comment by BE. Consideration of mechanical difficulties, of various systems of locking. Dimensions of existing lock systems of world.

Adaptation of the plan proposed to Washington Canal.

Detailed ests. of a canal lock, 8' lift, old plan, and by new plan; the first, $72,722.50; and the second, $53,210.55.

Names of some of the greatest navigable Rs. in the U. S.

69, 529–548.

MISC. 123. CANALS—RULES AND REGULATIONS FOR THE NAVIGATION OF CANALS AND SIMILAR WORKS OF NAVIGATION.

Section 4 of the R. and H. act of Aug. 18, 1894, as amended by section 11 of the R. and H. act of June 13, 1902, delegates to the Sec. of War the duty of prescribing such rules and regulations for the use, administration, and navigation of any or all canals and similar works of navigation that now are or that hereafter may be owned, operated, or maintained by the U. S., as in his judgment the public necessity may require; and he is also au. to prescribe regulations to govern the speed and movement of vessels and other water craft in any public navigable chan. which has been imp. under au. of Congress, whenever, in his judgment, such regulations are necessary to protect such imp. chans. from injury, or to prevent interference with the operations of the U. S. in imp. navigable waters, or injury to any plant that may be employed in such operations. Such rules and regulations have been estab. for the following-named works:

Ahnapee, Wis. **04,** 710.
Apalachicola, Fla. **09,** 911.
Appomattox R., Va. **04,** 710.
Ashtabula, Ohio. **03,** 641.

Baltimore, Md. **03,** 641.
Bayou Plaquemine. **05,** 718; **12,** 1294.
Big Sandy R., W. Va. and Ky. **02,** 580.
Black Warrior R., Ala. **02,** 580; **04,** 710.
Brunswick, Ga. **04,** 710.
Buffalo Bayou, Tex. **09,** 911.
Buffalo, N. Y. **03,** 641.

Cape Charles City, Va. **04,** 710.
Cape Fear R., N. C. **11,** 1078; **12,** 1294.
Cascades Canal, Columbia R., Oreg. **02,** 580.
Charlevoix, Mich. **04,** 710; **05,** 718.
Charlotte, N. Y. **03,** 641.
Chesapeake B., York Spit Chan. **12,** 1294.
Christiana R., Del. **10,** 1019.
Cleveland, Ohio. **03,** 641; **11,** 1078.
Columbia R., Oreg. (See Cascades, above.) **09,** 911.
Conneaut, Ohio. **03,** 641.
Cumberland R., Tenn. and Ky. **05,** 718.

Darien, Ga. **04,** 710.
Davis Isld. Dam, Ohio R. **02,** 580.
Delaware R., Schooner Ledge. **05,** 718.
Des Moines Rapids Canal, Mississippi R. **02,** 580.
Detroit R., Mich. **07,** 815.
Duluth-Superior H., Minn. and Wis. **02,** 580; **09,** 911; **10,** 1019; **11,** 1078.

Fairport, Ohio. **03,** 641.
Fernandina, Fla. **04,** 710.
Fox R., Wis. **02,** 580.
Frankfort, Mich. **04,** 710; **05,** 718.

Galena R., Ill. **02,** 580.
Galveston Chan., Tex. **10,** 1019; **12,** 1294.
Grand Haven, Mich. **04,** 710; **05,** 718.
Grand R. **12,** 1294.
Green and Barren Rs., Ky. **02,** 580.
Gulfport, Miss. **08,** 866.

Hampton Roads, Va. **04,** 710.
Hillsboro B., Fla. **05,** 718; **09,** 911.
Holland, Mich. **04,** 710; **05,** 718.
Huron, Ohio. **03,** 641.

Illinois and Mississippi Canal, Rock R. **02,** 580.
Illinois R., Ill. **02,** 580.

Kanawha R., W. Va. **02,** 580; **07,** 815.
Kenosha, Wis. **04,** 710.
Kentucky R., Ky. **02,** 580.
Kewaunee, Wis. **04,** 710.

Lake Superior, Wis. **10,** 1019.
Little Kanawha R., W. Va. **02,** 580.
Lorain, Ohio. **03,** 641; **11,** 1078.
Louisville and Portland Canal, Ky. **02,** 580; **11,** 1078.
Ludington, Mich. **04,** 710; **05,** 718.

Manistee, Mich. **05,** 718.
Manitowoc, Wis. **04,** 710.
Menominee, Mich. **04,** 710.
Michigan City, Ind. **04,** 710.
Milwaukee, Wis. **04,** 710.
Mississippi R., New Orleans, La. **12,** 1294.
Mobile, Ala. **11,** 1078.
Monongahela R., Pa. and W. Va. **02,** 580; **03,** 641.
Morgans Cut and Canal., Tex. **02,** 580.
Muscle Shoals Canal, Tenn. R. **02,** 580.
Muskegon, Mich. **04,** 710; **05,** 718.
Muskingum R., Ohio. **02,** 580; **10,** 1019.

Nansemond R., Va. **04,** 710.
New York H., Ambrose Chan. **05,** 718.
Niagara R., N. Y. **12,** 1294.
Norfolk, Va. **04,** 710.
Norfolk, Va., to Albemarle Sound, N. C. **04,** 710.

Ohio R., ls. and ds. **12,** 1294.

Pagan R., Va. **12,** 1294.
Pamlico Sound to Beaufort Inlet, N. C. **11,** 1078.
Pascagoula R., Miss. **12,** 1294.
Pentwater, Mich. **04,** 710; **05,** 718.
Petoskey, Mich. **04,** 710; **05,** 718.
Portage Lake, Mich. **04,** 710; **05,** 718.
Portage Lake Ship Canals, Mich. **02,** 580; **04,** 710; **07,** 815.
Port Arthur Ship Canal, Tex. **09,** 911.
Port Washington, Wis. **04,** 710.

Racine, Wis. **04,** 710.
Rough R., Ky. **02,** 580.

Sabine-Neches Canal, Tex. **09,** 911.
St. Clair Flats Canal, Mich. **02,** 580; **07,** 815.

St. Clair R., Mich. **07,** 815; **09,** 911.
St. Croix R., Minn. **07,** 815.
St. Johns R., Fla. **04,** 710.
St. Joseph, Mich. **04,** 710; **05,** 718.
St. Marys Falls Canal, Mich. **02,** 580.
St. Marys R., Mich. **02,** 580; **07,** 815.
San Diego, Cal. **05,** 718.
Sandusky H., Ohio. **02,** 580.
San Juan H., Porto Rico. **09,** 911.
Saugatuck, Mich. **04,** 710; **05,** 718.
Savannah, Ga. **04,** 710.
Savannah, Ga., to Fernandina, Fla. **04,** 710.
Sheboygan, Wis. **04,** 710.
South Haven, Mich. **04,** 710; **05,** 718.
South Pass, La. **03,** 641.
Southwest Pass, La. **09,** 911.
Sturgeon B. and Lake Michigan Ship Canal, Wis. **02,** 580; **08,** 866.

Tampa, Fla. **09,** 911.
Taylors Bayou, Tex. **09,** 911.
Tennessee R. **12,** 1294.
Tombigbee R., Ala. **04,** 710.
Two Rivers, Wis. **04,** 710.

Vicksburg, Miss. **05,** 718.

Wabash R., Ind. and Ill. **02,** 580.
Warrior R., Ala. **04,** 710.
Waukegan, Ill. **04,** 710.
White Lake, Mich. **04,** 710; **05,** 718.
White R., Ark. **05,** 718.
Willamette R., Oreg. **09,** 911.

Yamhill R., Oreg. **02,** 580.
Yazoo R., Miss. **05,** 718.

MISC. 124. COMMISSIONS—CALIFORNIA DÉBRIS COMMISSION.

Act of Congress approv. Mar. 1, 1893, provided for the estab. of the California Débris Commission, to consist of 3 officers of the Corps of Engineers, appointed by the President, with the concurrence of the Senate, whose functions relate to hydraulic mining in the territory drained by the Sacramento and San Joaquin R. systems in California.

The commission empowered and required to adopt plans for imp. the navigation of the Rs. in the systems mentioned, to project and construct works for impounding detritus and preventing the deterioration of the Rs. from the deposit of hydraulic mining and other débris, and to devise means and issue permits for resuming and carrying on hydraulic mining operations under conditions that will not injure other interests in the State. The powers of the commission, methods of procedure, etc., are prescribed in the act in detail.

ENGINEERS.

In charge:

Lt. Col. G. H. Mendell. **R., 82,** 2543–2640.
R. A. H. Payson. **R., 82,** 2584.
M. Manson. **R., 82,** 2604.
A. Larson. **R., 82,** 2632.

Débris Commission. R., 94, 3169; **95,** 4049, 4062; **96,** 3861; **97,** 3961; **98,** 3549; **99,** 3747; **00,** 5007: **01,** 1657.

NOTE.—For the detailed Rs. of the commission, see p. 1580 of this index.

MISC. 125. COMMISSIONS — MISSISSIPPI RIVER COMMISSION.

The Mississippi R. Commission, constituted by act of Congress of June 28, 1879, is in charge of the imp. of the Mississippi R. from Head of Passes to the vicinity of the mouth of Ohio R., including the rectification of Red and Atchafalaya Rs. at their junction with the Mississippi, the building of levees, and the imp. of the several Hs. for which specific apps. have been made, with the exception of the H. of Vicksburg and the mouth of Yazoo R. It is also charged with the survey of the Mississippi R. from Head of Passes to its headwaters. **01,** 658.

(See also p. 1067 of this index.)

MISC. 126. COMMISSIONS — MISSOURI RIVER COMMISSION.

The Missouri R. Commission, constituted by act of Congress of July 5, 1884, was in charge of the imp. and surs. of the Missouri R. below Sioux City, Iowa. **01,** 658.

Commission was abolished by R. and H. act June 13, 1902. Work continued under immediate charge of officers of the Corps of Engineers. **03,** 406.

(See also p. 1037 of this index.)

MISC. 127. DAMS, DOLPHINS, WEIRS, AND STRUCTURES OTHER THAN BRIDGES.

(See p. 2137 of this index.)

MISC. 128. FUNDS CONTRIBUTED BY STATES, MUNICIPALITIES, AND PRIVATE PARTIES.

1910, $191,263.22. 10, 33.
1911, $54,612.06. 11, 33.
1912, $132,361.90. 12, 32.

MISC. 129. HARBOR LINES.

(See p. 2137 of this index.)

MISC. 130. HARBOR LINES—ABROGATION OF.

"Hell Gate" passage, East R., N. Y., about Great and Little Mill Rocks—pierhead and bulkhead lines estab. Mar. 9, 1892, were abrogated by War Department action o Oct. 24, 1911. 12, 1293.

MISC. 131. RIVER AND HARBOR WORKS—PRIVATE OR NON-UNITED STATES WORK.

The reports of the Chief of Engineers contain references to important non-U. S. works of imp. in connection with Rs. and Hs. Such references are collected under the subhead of "Private work" in the abstracts of R. and H. Rs., pages 17-1691 of this index.

(See also below.)

Imps. on navigable waters of the U. S. by municipalities, private corporations, or individuals—Information relative to imp. of Hs. and Rs. which has included or will include inner Hs., or portions of Rs. or inlets within shore lines or corporate city limits, or chans. adjacent to wharves (reported under sec. 13 of the R. and H. act approv. June 13, 1902). The foregoing is a collection of reports rendered by each district office of the Engineer Department concerning what non-U. S. works have been done in the respective districts. 02, 2567-2649.

MISC. 132. LOGS, ETC.—RULES AND REGULATIONS GOVERNING FLOATING OF.

Act May 9, 1900, au. Sec. of War to make regulations governing running of loose logs, etc., on certain Rs. and streams. 02, 580.

Sec. of War prescribed rules and regulations for—

Navigation of Ocklockonee R., Fla.; St. Croix R., Wis. and Minn., above Lake St. Croix; Big Fork R., Minn.; Red Lake R., Minn.; Cheboygan R., Mich.; and North Fork of Coquille R., Oreg. 04, 711.

Navigation of Little R., Ark. and Mo.; Red Lake R., Big Fork R., and Rainy R., Minn. 05, 719.

Navigation of "Inland route," so called, and connecting waters between Cheboygan and Conway, Mich. 09, 912.

R., 11, 1078; 12, 1295.

MISC. 133. MISSOURI RIVER—SIX-FOOT CHANNEL.

(See p. 1037.)

Under the provisions of section 1 of the R. and H. act of June 25, 1910, a board consisting of Col. Frederic V. Abbot, Corps of Engineers; Col. C. McD. Townsend, Corps of Engineers; and Maj. Charles Keller, Corps of Engineers, was appointed by the Sec. of War to consider and report upon the most economical and desirable plan for the imp of Missouri R., with a view to securing a permanent 6′ chan. bet. Kansas City and the mouth of the R., consideration to be given in said R. to the subject of cooperation on the part of local interests in the work of said imp., and R. thereon, dated Nov. 29, 1910, was transmitted to Congress and printed in H. D. No. 1287, 61st, 3d. A plan for imp. at an est. cost of $20,000,000 plus the cost of mainten., ultimately reaching $500,000 an., with an addl. cost for snagging not exceeding $60,000 an., presented. **10,** 1014; **11,** 706.

MISC. 134. NAVIGATION — PERMANENT INTERNATIONAL COMMISSION OF CONGRESSES OF NAVIGATION.

1902. By act approv. June 28, 1902, Congress app. the sum of $3,000 per year for the support and mainten. of the Permanent International Commission of Congresses of Navigation, and for the payment of the actual expenses of the properly accredited national delegates of the U. S. to the meeting of the congresses and of the commission.

The ninth international congress of navigation was held at Dusseldorf, Germany, in June, 1902. 3 delegates were appointed to represent the U. S., namely, Lt. Col. C. W. Raymond, Corps of Engineers, and Messrs. B. M. Harrod and John Bogart, civil engrs. Lt. Col. Raymond and Mr. Bogart attended the congress.

1903. "The U. S. is represented on the Permanent International Commission of Congresses of Navigation, and on the permanent executive committee of that commission, Lt. Col. Raymond being the principal representative, and Mr. E. L. Corthell, C. E., the substitute. Lt. Col. Raymond attended a meeting of the commission held at Brussels, Belgium, on June 8, 1903.

The expend. during the year from the app. made by Congress have been for the expenses of the properly accredited national delegates to the meeting of the congress and of the Permanent International Commission, and for the support and mainten. of the commission, to which the U. S. contributes $1,000 per annum." **03,** 639.

1904. U. S. members increased to 5 by appointment of Maj. H. F. Hodges, Corps of Engineers; Maj. J. C. Sanford, Corps of Engineers; and Mr. John Bogart, civil engr. Mr. Corthell attended a meeting of the commission held at Brussels, Belgium, on May 2, 1904. **04,** 708.

1905. The tenth international congress to be held at Milan, Italy, Sept., 1905. Following have been appointed delegates to represent U. S. at meeting: Maj. H. F. Hodges, Corps of Engineers; Maj. J. C. Sanford, Corps of Engineers; Mr. J. A. Ockerson, civil engr.; Brig. Gen. C. W. Raymond, U. S. Army., retired; Mr. John Bogart, Mr. E. L. Corthell, Maj. Gen. G. L. Gillespie, U. S. Army, retired; and Messrs. W. W. Bates, H. W. Ashley, and John A. Sullivan. **05,** 718.

1906. Meeting of commission at Milan, Italy, Sept. 23, 1905, attended by Mr. Corthell, Maj. Hodges, and Maj. Sanford. Maj. Sanford attended meeting held at Brussels, Belgium, May 28, 1906. Mr. Corthell attended a meeting of executive committee at Milan, Italy, Sept., 1905. Maj. Hodges, Maj. Sanford, Mr. Ockerson, and Mr. Corthell attended meeting at Milan, Italy, Sept., 1905.

1907. Maj. Sanford attended a meeting of commission held at Brussels, Belgium, May 6, 1907. Questions decided pertaining to proposed eleventh international congress to be held at St. Petersburg, Russia, in 1908. **07,** 814.

1908. Maj. Sanford attended a meeting of commission at St. Petersburg, Russia, May 31, 1908. Eleventh international congress of navigation held at St. Petersburg, Russia, May 31 to June 7, 1908. Following delegates appointed to represent U. S.: Maj. J. C. Sanford, Corps of Engineers, chairman; Lt. Commander F. L. Chapin, U. S. N.; Maj. Spencer Cosby, Corps of Engineers; Mr. J. A. Ockerson, civil engr.; and Mr. Arsene Perrilliat, civil engr. All delegates, except Mr. Perrilliat, attended. **08,** 864.

1909. Col. Sanford attended meeting of commission at Brussels, Belgium, May 17, 1909; also meeting of executive committee, May 15, 1909. **09,** 910

1910. No meeting held. Act June 25, 1910, app. $50,000 to defray expenses of foreign delegates in inspection of U. S. waterways in the proposed meeting in U. S. **10,** 1017.

1911. Under date Sept. 2, 1910, following addl. delegates appointed: Brig. Gen. Wm. H. Bixby, Corps of Engineers, U. S. Army; Hon. J. Hampton Moore, M. C. Two meetings held at Brussels, Belgium, July 30, 1910, and May 15, 1911. U. S. represented by Mr. Corthell and Lt. Col. Sanford. Office opened at Philadelphia; circulars issued and distributed. **11,** 1076.

1912. Meeting held at Philadelphia, May 22, 1912. U. S. represented by Gen. Bixby, Lt. Col. Sanford, Mr. Corthell, Mr. Bogart, and Mr. Moore. The twelfth international congress of navigation held at Philadelphia, May 23-28, 1912. City of Philadelphia app. $50,000 for entertaining members, and funds provided by other places. **12,** 1291.

MISC. 135. NEW YORK HARBOR—SUPERVISION.

NOTE.—The office of supervisor of the H. of New York was created by act of Congress approv. June 29, 1888, entitled "An act to prevent obstructive and injurious deposits within the H. and adjacent waters of New York City, by dumping or otherwise, and to punish and prevent such offenses." This act has been amended by section 3 of the act of Aug. 18, 1894, entitled "An act making apps. for the constr., repair, and preservation of certain public works on Rs. and Hs., and for other purposes," by which amendment the functions and powers of the officer have been greatly enlarged. Addl. duties are also conferred on the supervisor by section 2 of the last-named act.

Under the provisions of section 5 of the act of June 29, 1888, a line officer of the Navy is designated to discharge the duties created by the act under the direction of the Sec. of War. On May 23, 1889, the Sec. of War directed that all communications in connection with these duties should be addressed to him through this office, and on Feb. 1, 1890, he further directed that the powers conferred upon him by the act should be exercised through the Chief of Engineers. **01**, 656.

APPROPRIATIONS.

1888,	$30,000, **90**, 3081.
1889,	34,070, **90**, 3081.
1889,	60,000 (purchase of vessel), **90**, 3081.
1890,	33,000, **91**, 3394; **92**, 2881.
1891,	33,000, **92**, 2881.
1893,	33,000, **93**, 3544.
1894,	33,000, **94**, 2686.
1895,	76,000, **95**, 3614.
1896,	96,000, **96**, 3400.
1897,	59,000, **97**, 3503.
1898,	59,000, **98**, 3134.
1899,	59,000, **99**, 3289.
1899,	110,500, **00**, 4524.
1900,	76,100, **01**, 3623.
1901,	76,100, **01**, 3623.
1902,	72,800, **02**, 2441.
1903,	80,260, **03**, 2366.
1904,	120,260, **04**, 3691.
1905,	73,260, **05**, 2582.
1906,	85,260, **06**, 2067.
1907,	80,260, **07**, 2252.
1908,	90,260, **08**, 2336.
1909,	85,260, **09**, 2294.
1910,	85,260, **10**, 2614.
1911,	100,260, **11**, 2925.
1912,	85,260, **12**, 3447.
Total,	1,826,170

ENGINEERS.

Chief of Engineers. **R.**, **90**, 330; **91**, 422; **92**, 395; **93**, 459; **94**, 420; **95**, 468; **96**, 418; **97**, 524; **98**, 527; **99**, 615; **00**, 693; **01**, 656; **02**, 576; **03**, 637; **04**, 705; **05**, 713; **06**, 792; **07**, 808; **08**, 858; **09**, 904; **10**, 1009; **11**, 1067; **12**, 1281.

NAVAL OFFICERS:

Capt. W. A. Kirkland. **R.**, **90**, 3077; **91**, 3393.

Capt. F. Rodgers. **R.**, **92**, 2879; **93**, 3541.

Lt. Commander D. Delehanty. **R.**, **94**, 2681; **95**, 3609; **96**, 3395; **97**, 3499.

Lt. J. F. Parker. **R.**, **97**, 3499; **98**, 3131.

Lt. Commanders W. L. Field and N. J. K. Patch. **R.**, **98**, 3131.

Lt. Commanders N. J. K. Patch, J. C. Fremont, and E. J. Berwind. **R.**, **99**, 3281.

Lt. Commander J. C. Fremont. **R.**, **00**, 4513.

Lt. Commander H. M. Hodges, U. S. Navy. **R.**, **01**, 3607; **02**, 2435.

Commander E. F. Qualtrough, U. S. Navy. **R.**, **02**, 2435; **03**, 2359.

Commander Daniel D. V. Stuart, U. S. Navy. **04**, 3677.

Commander H. H. Hosley, U. S. Navy. **05**, 2573; **07**, 2245.

Lt. Commander L. R. De Steigner, U. S. Navy. **R.**, **06**, 2059.

Capt. Aaron Ward. **R.**, **08**, 2325; **09**, 2281.

Capt. C. McR. Winslow. **R.**, **10**, 2601; **11**, 2915.

Commander J. T. Carter. **R.**, **12**, 3441.

Legal Action (1900-1912—Typical of Work of Preceding Years).

CASES.

Tug *Geo. L. Garlick*, began 1898, still pending June 30, 1901. **01**, 3615. Nol-prossed. **02**, 2441.

Tug *F. N. Brown*, closed by payment of fine. **01**, 3615. Copy of opinion and decision. **01**, 3616, 3617.

Tug *Emma K. Ross*, closed by payment of fine and imprisonment, copy of opinion and decision. **01**, 3618.

Tug *John Fleming*, case pending. **01**, 3620. Nol-prossed. **02**, 2440.

Tug *W. J. Sewall*, case pending. **01**, 3621. Nol-prossed. **02**, 2440.

Tug *Genesta*, case pending. **01**, 3621. Nol-prossed. **02**, 2440.

Tug *John Fleming*, fine paid. **01**, 3622.

Tug *M. Moran*, pending. **01**, 3622; **02**, 2440. Fine paid. **03**, 2365.

Tug *James D. Leary*, held for grand jury. **01**, 3622.

Tug *Agnes*, fine paid. **01**, 3623.

Tug *Emma J. Kennedy*, decision reserved. **02**, 2439. Pending. **03**, 2365. Fine paid. **04**, 3688.

Tug *George D. Kuper*, fine paid. **03**, 2363.

Tug *John Fleming*, 2 cases, fines paid. **03**, 2364.

Tug *Fidelity*, case held for October term. 04, 3689. Pending. 05, 2577. Fine paid. 06, 2063.

Tug *Senator Rice*, case pending. 04, 3689. Pending. 05, 2578. Acquitted. 06, 2063.

Tug *John Fleming*, case pending. 04, 3689. Jacobsen pleads guilty; sentence suspended. 05, 2578.

Tug *Wm. H. Flannery*, case pending. 04, 3689. Pending. 05, 2578. Nolled. 06, 2063.

Tug *John D. Dailey*, case pending. 04, 3690. Pending. 05, 2578. Nolled. 06, 2063.

Tug *John Fleming*, case pending. 05, 2578. Fine paid. 06, 2064.

Tug *H. G. Runkle*, case pending. 05, 2579; 06, 2064; 07, 2249; 08, 2331. Nolle-prossed. 09, 2289.

Tug *Jas. A. Lawrence*, case pending. 05, 2579. Dismissed. 06, 2064.

Tug *Colonel Gaynor*, case pending. 05, 2580. Fine paid. 06, 2064.

Tug *Bee*, case pending. 05, 2580. Sentence suspended. 06, 2064.

Tug *E. K. Ross*, fine paid. 05, 2581.

Tug *John Fleming*, case pending. 05, 2581. Fine paid. 06, 2064.

Tug *Chas. E. Matthews*, case pending. 06, 2065. Fine paid. 07, 2249.

Tug *John Fleming*, case pending. 06, 2065. Fine paid. 07, 2249.

Brown & Fleming Cont. Co., case pending. 06, 2065; 07, 2249.

Tug *John Fleming*, case pending. 06, 2066. Fine paid. 07, 2249.

Tug *Nonpareil*, case pending. 06, 2066. Fined, remitted. 07, 2249.

Tug *John T. Pratt*, case pending. 06, 2066. Fined. 07, 2249.

Tug *Success*, fined. 07, 2250.

Tug *O. L. Halenbeck*, case pending. 07, 2250 Fined. 08, 2331.

Tug *Julia C. Moran*, fined. 07, 2251.

Tug *Robt. M. Duy*, fined. 08, 2332.

Tug *M. Moran*, failed to indict. 08, 2332.

Tug *Bouker No. 2*, fined. 08, 2333.

Tug *Julia C. Moran*, indictment dismissed. 08, 2333.

Tug *Franklin N. Brown*, ignored by grand jury. 08, 2333.

Tug *P. J. T. Co. No. 7*, matter never brought before court. 08, 2335. (Correspondence with U. S. attorney. 08, 2334, 2335.)

Tug *E. F. Moran*, license of master suspended 30 days. 08, 2335.

Steamship *Deutschland*, case pending. 09, 2289. Nolle-pros. entered. 10, 2609.

Tug *Franklin N. Brown*, case pending. 09, 2289; 10, 2609.

Tug *Wm. H. Taylor*, fine paid. 09, 2290.

Tug *Bouker No. 2*, fine paid. 09, 2290.

Tug *Bee*, case pending. 09, 2291; 10, 2609.

Tug *O. L. Halenbeck*, fine paid. 09, 2291.

Tug *Ariosa*, fine paid. 09, 2291.

Tugs *Leonard Richards* and *O. L. Halenbeck* Hastorf paid fine, others nol-prossed. 09, 2292.

List of cases referred to U. S. district attorney, showing disposition. 09, 2292.

Tug *M. Moran*, fine paid. 10, 2610.

Tug *John F. Gaynor*, fine paid. 10, 2610.

Tug *M. Moran*, fine paid. 10, 2611.

Tugs *Col. Gaynor* and *Eugene Hughes*, case dismissed, lack of evidence. 10, 2611.

Tug *Julia C. Moran*, no bill found. 10, 2611.

Tug *O. L. Halenbeck*, fine paid. 10, 2612.

Tug *Edmund Moran*, pending. 10, 2613. Fine paid. 11, 2923.

Tomasso Rici, foreman, street cleaners, defendant, discharged. 10, 2613.

List of cases showing disposition made. 10, 2613.

Wm. Beard & Co., civil action now at issue. 11, 2923; 12, 3445.

Morris & Cumings Dr. Co., civil action "now" at issue. 11, 2923, 2924; 12, 3445.

Cahill Towing Co., pending. 11, 2924; 12, 3445.

Tugs *Anna W.* and *O. L. Halenbeck*, pending. 11, 2924 12, 3445.

List of cases, showing disposition made. 11, 2924.

The Moran Towing & Transportation Co., pending. 12, 3445.

OPERATIONS (1901-12; typical of works of preceding years).

1900–01. Patrol plant small compared to territory to be watched. 01, 3607. Owners of tugboats and dredging plants realize efficiency of patrol and checking system. 01, 3609. Contractors find it to their interest to keep plants in good condition rather than suffer penalty. 01, 3609. About 12,000,000 c. y. moved yearly. 01, 3610. Change in location of dumping ground, notice given. 01, 3610. Employees of those engaged in dumping resort to every subterfuge to evade the law. 01, 3611. Waste material used for filling in and reclaiming land. 01, 3611. Correspondence relative to street sweepings being deposited at mouth of H. 01, 3612. Efforts must be directed against employment of inferior or unseaworthy vessels upon work of transporting waste material to sea. 01, 3614. 12,059,450 c. y. material deposited during fiscal year. 01, 3623.

1901–02. Imp. to dispose of waste material without knowledge of this office. 02, 2436. In consequence of strict surveillance owners and masters endeavor to conform to all rules and regulations. 02, 2436. Difficulty in controlling dumping of ashes from small steam craft. 02, 2436. About 19,000,000 c. y. removed during years. 02, 2439.

1902–03. Condition of plant. 03, 2360. System of checking material described. 02, 2361. 20,460,587 c. y. moved and deposited. 03, 2365.

1903–04. Remarks relative to repairs to vessels. 04, 3679. Existence of shoal; notice sent out. 04, 3680. Navigation menaced by planting of nets and poles in shad-fishing industry; notice given by supervisor forbidding these obstrs. 04, 3685. 18,833,927 c. y. moved and deposited. 04, 690.

1904–05. Piles and lumber obstrs. endanger navigation. **05,** 2576. Long tow lines interfere with navigation. **05,** 2577. 20,707,889 c. y. moved and deposited. **05,** 2582.

1905–06. Disposed refuse material increased from 10,000,000 c. y. in 1896 to 21,973,038 c. y. in 1906. **06,** 2059. Action to regulate length of tow lines suggested. **06,** 2061. 21,973,038 c. y. moved and deposited during fiscal year. **06,** 2067.

1906–07. Perceptible decrease in amount of spoil and refuse by diminution of work on tunnels, etc. **07,** 2245. Urgent recom. for a new patrol boat; est., $50,000. **07,** 2247. 18,636,856 c. y. moved. **07,** 2251.

1907–08. 22,952,563 c. y. moved and deposited. **08,** 2336.

1908–09. 29,096,882 c. y. moved and deposited. **09,** 2293.

1909–10. Act requiring boats or scows to be equipped at all times with certain specified articles for better protection of life and property. **10,** 2602. Methods of inspection. **10,** 2602. 27,535,295 c. y. moved and deposited. **10,** 2614.

1910–11. Remedial measures suggested for adoption by city in disposing of refuse. **11,** 2921. 20,451,546 c. y. moved and deposited. **11,** 2925.

1911–12. 19,623,976 c. y. moved and deposited. **12,** 3446.

MISC. 136. NIAGARA FALLS, ETC.—CONTROL AND REGULATION OF THE WATERS OF NIAGARA RIVER, AND PRESERVATION OF NIAGARA FALLS.

APPROPRIATION.

1906, $50,000, **07,** 855.

ENGINEERS.

Chief of Engineers. **R., 06,** 798; **07,** 854; **08,** 893; **09,** 939; **10,** 1050; **11,** 3022; **12,** 1331.

In charge:

Maj. C. Keller. **R., 07,** 2457; **08,** 2538; **09,** 2503.

Maj. C. S. Riche. **R., 10,** 2722 (Lt. Col.); **11,** 3005; **12,** 3529.

PERMITS.

For diversion of water. . **08,** 895.

For transmission of electrical power from Canada into the U. S. **08,** 895.

Table, operating limitations of Niagara Falls Power Co. **10,** 2724; **12,** 3551.

Hearing in re application of Federal Light & Power Co. **12,** 3552.

SURVEYS, OPERATIONS, AND PROJECTS.

1906. By act of Congress approv. June 29, 1906, the diversion of water from Niagara R. or its tributaries, in the State of New York, is prohibited, except with the consent of the Sec. of War as au. in section 2 of said act, and the act provides that this prohibition shall not be interpreted as forbidding the diversion of the waters of the Great Lakes or of Niagara R. for sanitary or domestic purposes, or for navigation, the amount of which may be fixed from time to time by the Congress of the U. S. or by the Sec. of War under its direction. **06,** 798.

1907. **R.** by Capt. Kutz concerning power companies on American and Canadian sides. Sur. made. **R.** of Asst. Engr. F. C. Sherehon printed. **07,** 855, 2457.

1908. Details of field operations. **08,** 2538.

Tables, discharge of Niagara R. **09,** 2503.

Slopes of Niagara R., table of R. heights at several gauges. **11,** 3022. Changes in R. heights, 1906-10. **11,** 3025. Simultaneous gauge heights and misc. factors. **11,** 3026.

MISC. 137. RIVERS—OHIO RIVER.

(See District CC., p. 905 of this index.)

The R. and H. act approv. June 25, 1910, made provision for continuing imp. of the Ohio R. with a view to securing a navigable d. of 9′ in accordance with the R. submitted in H. D. 492, 60th, 1st, and with a view to the completion of such imp. within a period of 12 years. The item making app. for this work is as follows:

"Imp. Ohio R.: Continuing imp. with a view to securing a navigable d. of 9′ in accordance with the R. submitted in H. D. 492, 60th, 1st, or such modification thereof as in the discretion of the Sec. of War may be advisable, and with a view to the completion of such imp. within a period of 12 years, $1,150,000, which amount shall be applied to the purchase of sites for 18 ls. and ds. Nos. 9, 10, 12, 14, 15, 16, 17, 20, 21, 22, 23, 24, 25, 27, 28, 29, 41, and 48, and toward the constr. of ls. and ds. Nos. 7, 9, 10, 12, 19, 20, 29, 41, and 48: Provided, That so much of the sum herein app. as shall be necessary may be applied toward the definite location and purchase of sites for addl. ls. and ds. on said R.: Provided further, That the Sec. of War may enter into a contract or contracts for such materials and work as may be necessary to prosecute the said proj., to be paid for as apps. may from time to time be made by law, not to exceed in the aggregate $3,500,000, exclusive of the amounts herein and heretofore app."

Work of creating slack-water navigation on the Ohio R. has been in progress for many years, first with a view to securing a d. of 6′ and afterwards a d. of 9′, and prior to the adoption of the new proj. the practical completion of 12 ls. and ds. and some work at 2 others had been provided for. Of these, Nos. 1-6, inclusive, and the d. at 41 were in operation; Nos. 13, 18, and 37 will be opened in the next few months, and Nos. 8, 11, 19, and 26 are well under way. The new proj. contemplates a total of 54 ls. and ds. est. at the time the R. was submitted (January, 1908) to cost $63,731,488, in addition to apps. previously made. This act also au. the purchase of sites for 18 ls. and ds., the beginning of the constr. of 9, and surs., etc., for the location of others.

The execution of the surs., the preparation of plans for the ls. and ds. "now" under constr. or contemplated, and other matters pertaining to the imp. as a whole are made the subject for consideration by a special board of Engineer officers constituted at the "present" time as follows: Col. Wm. T. Rossell, Corps of Engineers; Lt. Col. Henry C. Newcomer, Corps of Engineers; Capt. Frederick W. Altstaetter, Corps of Engineers.

Upon the recom. of the board, the following allotments have been made of the cash apps. provided under the new proj.:

Dam No.	R. and H. act of June 25, 1910.	R. and H. act of Feb. 27, 1911.	Sundry civil act of Mar. 4, 1911.	R. and H. act of July 25, 1912.	Sundry civil act of Aug. 24, 1912.
7	$150,000		$250,000	$150,000	$122,000
9	150,000		400,000	150,000	282,000
10	40,000			470,000	
12	150,000		300,000		
14		$330,000		100,000	
15		305,000		150,000	
19	220,000		300,000	100,000	
20	40,000	248,000			167,000
28		250,000		300,000	
29	150,000	52,000	460,000		
31				330,000	
41	50,000	300,000		420,000	570,000
43				550,000	
48	50,000	435,000			
Movable parts				230,000	
Surveys, etc	150,000	80,000		250,000	
Total	1,150,000	2,000,000	1,710,000	3,200,000	1,141,000

R. and H. act of Feb. 27, 1911: Imp. Ohio R.: Continuing imp. by the constr. of ls. and ds. with a view to securing a navigable d. of 9′, $2,000,000: Provided, That the Sec. of War may enter into a contract or contracts for such materials and work as may be necessary to prosecute the said proj., to be paid for as apps. may from time to time be made by law, not to exceed in the aggregate $3,000,000, exclusive of the amounts herein and heretofore app.

Sundry civil act of Mar. 4, 1911: Imp. Ohio R. below Pittsburgh, Pa.: For continuing imp. by the constr. of ls. and ds. Nos. 7, 9, 10, 12, 19, 20, 29, 41, and 48, $1,710,000.

R. and H. act of July 25, 1912: Imp. Ohio R.: Continuing imp. by the constr. of ls. and ds. with a view to securing a navigable d. of 9′, $3,200,000: Provided, That the Sec. of War may enter into a contract or contracts for such materials and work as may be necessary to prosecute the said proj., to be paid for as apps. may from time to time be made by law, not to exceed in the aggregate $2,200,000, exclusive of the amounts herein and heretofore app.

Sundry civil act of Aug. 24, 1912: Imp. Ohio R. below Pittsburgh, Pa.: For continuing imp. by the constr. of ls. and ds. Nos. 7, 9, 10, 12, 19, 20, 29, 41, and 48, $1,141,000.

(**10**, 1006; **11**, 1063; **12**, 1275.)

MISC. 138. PLANT--FLOATING PLANT.

(See p. 2337 of this index.)

Tabular statement in regard to each dr. and work accomplished by it during the preceding year. **09,** 899; **10,** 1009, 2449; **11,** 1066, 2661-2913; **12,** 1280, 2883-3439.

24 seagoing hy. dredges owned and operated by U. S. **09,** 899-903.

Work, and cost of, done by seagoing suction dredges. **10,** 2450; **11,** 2662; **12,** 3028.

Work, and cost of, pipe line hy. dredges. **10,** 2468; **11,** 2690; **12,** 3119, 3154.

Work, and cost of, dipper dredges. **10,** 2492; **11,** 2738; **12,** 3119, 3154.

List of floating plant, by classes. **10,** 2507; **11,** 2788; **12,** 2887.

List of floating plant, by districts. **10,** 2514; **11,** 2801; **12,** 2902.

Snagboats. **11,** 2763; **12,** 3174.

Derrick boats. **12,** 3203.

Pile drivers. **12,** 3228.

Graders. **12,** 3246.

Drill boats. **12,** 3252.

Maneuver boats. **12,** 3263.

Tow and survey boats (screw). **12,** 3267.

Tow and survey boats (paddle). **12,** 3304.

Steam lighters. **12,** 3302.

Gasoline launches (screw). **12,** 3348.

Gasoline launches (paddle). **12,** 3418.

Dry docks, list of. **12,** 3422.

Boat building plants. **12,** 3426.

Floating plants under construction. **12,** 3430.

Floating concrete plant. **12,** 3438.

MISC. 139. NAVIGATION — STRUCTURES IN THE NAVIGABLE WATERS OF PORTO RICO.

Act of Congress approv. June 11, 1906, empowered the Sec. of War, under certain restrictions, to au. the constr., extension, and mainten. of wharves, piers, and other structures on lands underlying H. areas and navigable streams and bodies of water in or surrounding Porto Rico and the islds. adjacent thereto.

Maj. C. A. F. Flagler, Corps of Engineers, to be sent to Porto Rico as a representative of the War Department to confer with the governor of Porto Rico, with a view to estab. some definite policy in dealing with applications for privileges under this law. **06,** 797.

Through a conference bet. the district officer and the governor of Porto Rico, definite policy estab. and followed in connection with applications for privileges under this law, several applications being acted on during the year. **07,** 816; **08,** 866; **09,** 912; **10,** 1019; **11,** 1078; **12,** 1295.

MISC. 140. WATER POWER.

The an. Rs. of the Chief of Engineers contain references to the utilization of navigable streams for water-power purposes, but such references are generally incorporated in the abstract pertaining to whatever stream is concerned. (See index to Rs. and Hs., pp. 17-1691 of this index, and see Topical Index.)

MISC. 141. WATER POWER — MICHIGAN-LAKE SUPERIOR POWER CO.

An. act June 13, 1902. Sec. of War, Dec. 12, 1902, to approv. plans of Michigan-Lake Superior Power Co. for its water-power canal and remedial works and diversion of water from St. Marys R. subject to conditions. **03,** 641.

MISC. 142. WATERWAYS, INTRACOASTAL — BOSTON, MASS., TO THE RIO GRANDE.

(See p. 2106 of this index.)

R. and H. act of Mar. 3, 1909, directed certain surs. to be made with a view to the constr. of a continuous waterway, inland where practicable, from Boston, Mass., to the Rio Grande, which were assigned to the boards of engineers.

R. dated Oct. 4, 1911, with maps, by the special board of Engineer officers, upon the sur. of that section of the proposed continuous inland waterway from Boston, Mass., to Beaufort Inlet, N. C., was duly submitted, and was reviewed by the BERH., pursuant to law, and its R. thereon submitted Dec. 12, 1911. These Rs. were transmitted to Congress and printed in H. D. 391, 62d, 2d. Projs. and ests. for imp. of the following section presented:

Boston to Narragansett B. section, $40,000,000.
Narragansett B.-Long Isld. Sound section, $12,322,000.
New York B.-Delaware R. section, $45,000,000.
Delaware R.-Chesapeake B. section, $12,424,500.
Norfolk-Beaufort Inlet section, $5,400,000.

Only the last 2 sections named above were recom. for adoption at the present time.

It is expected that the Rs. of the other boards on the sections between Beaufort Inlet and the Rio Grande will be transmitted to Congress during its next session. **10**, 1015; **11**, 1073; **12**, 1288.

MISC. 143. RIVER AND HARBOR WORKS—Deterioration of, and Discontinuance of Appropriations for River and Harbor Works Deemed Not Worthy of Further Improvement.

Rs., **99**, 38; **00**, 40, 5071.

MISC. 144. RIVER AND HARBOR WORKS—Occupation of, by Private Parties.

Rs., **88**, 310, 2687; **89**, 373, 2805; **90**, 13, 334, 3489; **91**, 19, 436, 3865; **92**, 22, 413, 3341; **93**, 20, 475, 4267; **94**, 20, 431, 3189; **95**, 21, 483, 4077; **96**, 24, 429, 3875; **97**, 24, 536, 3981; **98**, 35, 538; **99**, 38; **00**, 40, 5085.

MISC. 145. WRECKS.

The removal of wrecks within the navigable waters of the U. S. is one of the duties assigned by Congress to the Chief of Engineers.

(For list of wrecks removed, see p. 2137 of this index.)

MISC. 146. WRECKS—REMOVAL OF S. S. "CRISTOBAL COLON," SAN JUAN H., PORTO RICO.

Chief of Engineers. 01, 657.

In charge:
Capt. W. V. Judson, 1901.
Capt. C. A. F. Flagler, 1901.

OPERATIONS.

1900–01. The wreck of the iron-hull steamboat *Christobal Colon* in the entrance to San Juan H. was removed to a min. d. of 36′ at m. l. w. at a total cost of $7,759.27. **01**, 657.

MISC. 147. WRECKS—REMOVAL OF WRECK OF BATTLESHIP "MAINE."

APPROPRIATIONS.

1910,	$100,000	11, 3049.
1910,	200,000	
1911,	350,000	
	650,000	
1911,	250,000,	12, 1345.
	900,000	

CONTRACTS.

1910. Lackawanna Steel Co., furnishing sheet piling, plates, bolts, etc., prices listed. **11,** 3050.

Chief of Engineers. R., 11, 1119.

Board. Par. 1, S. O. 36, consisting of Col. W. M. Black, Lt. Col. M. M. Patrick, and Maj. H. B. Ferguson. **R., 11,** 3039; **12,** 3565.

OPERATIONS.

1910–11. Pile driving begun; dr. of bar done; cylinders filled with drs.; constant repairs made to piles damaged during operations; main deck of *Maine* and captain's cabin exposed; details of wreck as illustrated by exposed portions. **11,** 3049.

1911–12. The st. and clay fill against the inside of the dam completed in October, making a total of 86,766 c. y. of clay and 17,734 c. y. r. for entire work; unwatering of cofferdam continued; inside work finished in February; wreck examined; mainmast removed for transportation to Arlington Cemetery; remains of 66 men recovered, taken to U. S. for interment; cofferdam flooded; hull freed itself from mud and finally rose with water; on Mar. 16, 1912, wreck towed to sea and buried with proper ceremonies; work of removing cofferdam and restoring site started. **12,** 3568.

Rs. relative to removal of wreck and the progress thereof are printed in H. D. 919, 61st, 2d; S. D. 765, 61st, 3d. **R.** of board appointed by Sec. of Navy to examine wreck contained in H. D. 310, 62d, 2d.

PHYSICAL CHARACTERISTICS.

Description of Habana H. **11,** 3040.

Cyclonic disturbance passed over Habana, delaying work. **11,** 3043.

PROJECTS.

The removal of the wreck of the *Maine* from the H. of Habana is being carried on under acts approv. May 9, 1910, June 25, 1910, and Mar. 4, 1911. Requires Sec. of War to provide for raising and removal of the wreck and for proper interment of the bodies therein in Arlington Cemetery, to remove mast of wreck and place it upon a proper foundation in Arlington National Cemetery. Impossible to prepare an accurate est. of sum needed for work. **11,** 3039. Congress desires wreck to be so exposed, without derangement of parts, as to permit all information possible to be obtained as to the nature and location of the explosion or explosions which caused disaster. **11,** 3041. Board approves design for a dam elliptical in shape, composed of cylinders 50′ diameter, built of steel sheet piles, driven to d. of 73′; cylinders placed tangent to each other, connected on the outer perimeters by short arcs of similar sheet piles, and with the cylinders and connecting sections filled with stiff clay from the H. bottom near by and rock. The centers of the cylinders were to be on a perimeter of elliptical form, with major and minor axes of 395′ and 216′ l., respectively. **11,** 3042.

MAPS.

H. of Habana. **11,** 3040.

Plan of cofferdam around wreck. **11,** 3042.

Photographs showing views of cofferdam, etc. **11,** 3050.

MISC. 148. ROADS—ALASKA.

APPROPRIATIONS.

1904,	$25,000	**04,** 4219 (Valdez-Fort Egbert sur.)
	2,500,	**04,** 4219 (Yukon-Coldfoot sur.).
	27,500	

ENGINEERS.

Chief of Engineers. R., 04, 744; **05,** 752.

In charge. Maj. J. Millis. **R., 04,** 4203; **05,** 2845.

OPERATIONS AND PROJECTS.

1904. Surs. for the above road and trail were provided for in the Army app. act of Apr. 23, 1904.

The Valdez-Fort Egbert road is some 400 m. l., and the Yukon-Coldfoot trail in the neighborhood of 90 m. l.

Coldfoot is on the headwaters of the Koyukuk, within the Arctic Circle, in latitude 67° 20′ n.

5 parties were organized in Seattle to make the surs.—1 for the Coldfoot trail and 4 for the Valdez-Fort Egbert road. The Coldfoot party and 2 of

the Valdez-Fort Egbert parties sailed from Seattle on May 31 for Skagway, from which point they were to go by the White Pass R. R. and the Yukon R. to the points of beginning their respective surs. 2 other parties sailed from Seattle for Valdez. **04**, 4217.

1905. The sur. from Yukon R. to Coldfoot, Alaska, was completed and party returned to Seattle on Aug. 31, 1904.

The sur. from Valdez to Fort Egbert, Alaska, was completed on Aug. 14, 1904, and the parties returned to Seattle on Sept. 29, 1904.

Pre. Rs. on the surs. were submitted on Dec. 15, 1904, and were published in H. D. 192, 58th, 3d. **05**, 2845.

MAPS.

04, 4218.

MISC. 149. ROADS—MOUNT RAINIER NATIONAL PARK.

APPROPRIATIONS.

Mar. 3, 1903, to enable the Sec. of War to cause a sur. to be made for a wagon road in said park and for constr. of the road	$10,000.	**04**, 4203
Apr. 28, 1904, for continuing the constr. of the wagon road, $6,000 of which shall be used in sur. and est. the cost of a wagon road from the e. boundary of Mount Rainier Forest Reserve into said park	30,000.	**04**, 4205
June 30, 1906, for continuing the constr. of the wagon road into the park from the w. side	50,000.	**06**, 831
Mar. 4, 1907, for continuing the constr. of the wagon road into the park from the w. side	50,000.	**07**, 472
May 27, 1908, for continuing the constr. of the wagon road into the park from the w. side	50,000.	**08**, 2554
Mar. 4, 1909, for completion of the wagon road into the park from the w. side	25,000.	**09**, 945
June 25, 1910, for addl. work upon the wagon road into the park from the w. side	25,000.	**10**, 1056
Total	240,000	

CONTRACT.

1904. A. D. Miller, road constr. **05**, 2844. (A. W. Miller. **07**, 2471.)

ENGINEERS.

Chief of Engineers. R., **03**, 37; **04**, 743; **05**, 751; **06**, 831; **07**, 857; **08**, 897; **09**, 944; **10**, 1055; **11**, 1117; **12**, 1339.

In charge:

Maj. J. Millis. R., **04**, 4203; **05**, 2839.

Lt. F. A. Pope. **06**, 831.

Maj. H. M. Chittenden. R., **06**, 2277; **07**, 2471; **08**, 2553.

Maj. C. W. Kurtz. R., **09**, 2514, 2739; **10**, 3033; **11**, 3033.

Maj. J. B. Cavanaugh. R., **12**, 3559.

Assistant. Eugene Ricksecker. R., **04**, 4207; **05**, 2840.

PHYSICAL CHARACTERISTICS.

Mount Rainier, sometimes known as Mount Tacoma, is an extinct volcano, the top of which is covered with perpetual snow. It has an elevation of 14,526′ above sea level, and from certain points of view has a remarkably symmetrical outline. It is detached from the main range of the Cascades, being several m. w. of that range. It is plainly in sight as a very conspicuous feature of the landscape from sea level at Tacoma, only 45 m. distant, and is of course visible from all directions to much greater distances. On account of its height, its symmetry, and its visibility from sea level from a large city and seaport, it is the most remarkable mountain peak in U. S. territory, and one of the remarkable features of its kind on the earth's surface.

Besides the mountain itself and its immense crater, which is still warm, the national park and forest reserve in which it is located contain many features of great scenic and scientific interest, including living glaciers, waterfalls, lakes, canyons, interesting rock formations, and vegetation of great variety and beauty. All these will be rendered accessible to tourists and the general public by the constr. of the roads in progress. **04**, 4204.

It seemed, 1903, as though best results would be secured by a road that, in connection with existing means of communication, would afford access to the mountain from Tacoma, the nearest large city, via Longmire Springs, the Nisqually glacier, and Narada Falls, to Paradise Valley and the Camp of the Clouds. From the latter the summit of the mountain can be reached by mountain climbers, at an elevation of 14,526′. **04**, 4204.

Bridges. **04**, 4214.
Clearing work. **04**, 4213.
Curves. **04**, 4213.
Drainage. **04**, 4213.
Gradients. **04**, 4212.
Grading. **04**, 4214.
Repairing roads and trails. **05**, 2841.
Retaining walls. **04**, 4214.
Road constr. **05**, 2842.
Surfacing. **04**, 4214.
Width of wheeling. **04**, 4212.

PROJECTS AND OPERATIONS.

Bids were invited in the latter part of the season of 1903 for beginning the clearing and grubbing of the road, but the proposals received were too high.

Bids again called for, for beginning the clearing and grubbing, but no fav. bid was received. Meanwhile, specifications were prepared for beginning the road constr. under formal contract and on a scale that w. enable contractors to undertake it to advantage.

The proposed road is to enter the park from the w., and, in connection with existing R. R. and stage lines, will render the various points of interest in the park, including glaciers, falls, r. formations, etc., also Paradise Valley, Camp of the Clouds, and the mountain summit, accessible for tourists and others from Tacoma, the nearest large city. **04,** 4203.

Contract made for road constr. into the park from the w. Work began in August, 1904, and was continued as long as the weather permitted. About 1 m. of clearing, grading, and grubbing was done, extending from Longmire Springs toward Paradise Park. Work was not resumed in the spring, owing to financial difficulties of the contractor. The contract time expired June 30, 1905, but the time was extended for a reasonable period. **05,** 751, 2839.

1907. Notification of annulment of contract with A. D. Miller for constr. of road was received at this office on July 8, 1906, and work was commenced with hired labor and Government plant July 9. Operations during the season of 1906 were carried on below Longmire Springs, and 6 m. of road built and about 1½ m. partly built between the w. boundary of the forest reserve and Longmire Springs. Work was carried on until Nov. 20, 1906, when it was suspended on account of unfav. weather.

Work was resumed on Apr. 9, 1907, and the uncompleted road below Longmire Springs was practically finished. **07,** 2471.

The work accomplished under the various apps. to the close of the fiscal year ending June 30, 1908, is as follows: Number of m. of road constr. and in use, 14; number of m. of road partially completed, 1.5; total, 15.5. **08,** 898.

1911. On July 1, 1910, the road was open for public travel from the w. boundary of the forest reserve to Narada Falls, a distance of 19.5 m. It was incomplete from Narada Falls to Camp of the Clouds, a distance of 4.5 m. The unfinished section was so far completed during the season of 1910 that the entire road was opened to the public Sept. 1, and a number of stages made regular trips between Longmire Springs and Camp of the Clouds during September. Work ceased Nov. 3, 1910, on account of rain and was resumed on June 26, 1911.

The work of the fiscal year included the removal of débris which had fallen from the slopes, the completion of the Narada trestle, other brs., and grading, widening, and surfacing the roadbed. **11,** 1117.

SURVEYS.

The sundry civil act of Mar. 3, 1903, au. a sur. for a wagon road into Mount Rainier National Park. **03,** 37.

The sur. was made during the summer and autumn of 1903, and pre. R., with detailed maps and est. of cost, were submitted on Feb. 9, 1904. A collection of photographic views, illustrating some of the natural features which the proposed road will render accessible, was also submitted.

The sundry civil act of Apr. 28, 1904, also provided for a sur. and est. for a road to enter the park from the e. Preparations to begin this sur. at an early date were under way at the close of the fiscal year. This road is to render the park and mountain accessible from North Yakima and Ellensburg. **04,** 4203.

The sur. for the road into the park from the e. was completed in October, 1904, and R. and est. were submitted on Jan. 16, 1905. The est. cost of the proposed road was $275,600.

The R. of the sur. was printed as H. D. 283, 58th, 3d. **05,** 2839.

MAPS.

04, 4206; (photographs) **08,** 2554; (photographs) **09,** 2514.

MISC. 150. ROADS—MILITARY ROAD, FORT WASHAKIE TO MOUTH OF BUFFALO FORK OF SNAKE RIVER, WYO.

ENGINEERS.

Chief of Engineers. **R., 99,** 640; **00,** 721; **01,** 686; **02,** 612; **03,** 675.

In charge:

Capt. J. C. Sanford. **R., 99,** 3881.

Capt. H. M. Chittenden. **R., 00,** 5453; **01,** 3823; **02,** 3075; **03,** 2937.

Assistants:

Lt. A. W. Perry, 9th Cav. **R., 99,** 3897.

Lt. J. A. Ryan, 9th Cav. **R., 99,** 3892.

W. H. Wood. **R., 99,** 3898.

PHYSICAL CHARACTERISTICS.

Detailed description of the routes. **99,** 3884.

PROJECT.

The sundry civil act June 4, 1897, app. $10,000 for military road from Fort Washakie, Wyo., by the most practicable route near the Wind R., and to the mouth of the Buffalo Fork of Snake R., near Jacksons Lake, in Uinta Co., Wyo.

The purpose of the road to render possible the movement of Cavalry from Fort Washakie with their supplies, by as direct a line as possible, into Jacksons Hole, a noted game country, much frequented during the hunting season by Indians of the Fort Hall and Wind R. Reservations, where conflicts between these Indians and the Wyoming State game wardens were to be feared.

1897, the work in charge of the Quartermaster Department, August, 1897, plan and map for locating the road prepared by Lt. H. R. Hickok, Ninth Cavalry. Judge Advocate General decides that as amount fell far short of the amount required to complete the work, the app. could not, by its terms, be used as far as it would go, leaving the work incomplete. 1897, a reconnoissance made by Lt. A. J. Perry, Ninth Cavalry., and Lt. J. A. Ryan, Ninth Cavalry. As a result, suggested that if whole of app. were expended on the section of the road from Clarks Ranch to the mouth of the Buffalo Fork of Snake R., that section could be made passable; and, as the road from Washakie to Clarks was already passable during the greater part of the year, the result of spending the whole of the app. bet. Clarks and the mouth of Buffalo Fork would be to give a passable road over the entire route. This decided legal by the Judge Advocate General.

Capt. J. T. McBlain, Ninth Cavalry, detailed to take charge of the constr. War with Spain stopped preparations. **99,** 3884.

Capt. J. C. Sanford, Corps of Engineers, placed in charge of the work, 1898. Work on the road begun Aug. 25. Completed Oct. 7. **99,** 2881.

Sundry civil act June 6, 1900, au. $10,000 for repair and completion of road. **01,** 687.

MISC. 151. SURVEYS — ERIE CANAL — PRESERVATION OF BENCH MARKS.

ENGINEERS.

Chief of Engineers. **R., 97,** 546; **98,** 551; **99,** 636; **00,** 715.

In charge:

Maj. W. S. Stanton. **R., 97,** 4122; **98,** 3778.

Capt. G. D. Fetch. **R., 99,** 3859; **00,** 5402.

MISC. 152. FRONTIERS—MEXICAN FRONTIER.

ENGINEERS.

Chief of Engineers. **R., 81,** 339.

In charge. Maj. O. M. Poe (Bvt. Brig. Gen.; Col., A. D. C.). **R., 81,** 2811; **82,** 2825.

MISC. 153. SURVEYS — GEOLOGICAL AND GEOGRAPHICAL SURVEYS OF THE WAR DEPARTMENT.

ENGINEERS.

Chief of Engineers.

Information for Congress relating to investigations of all surs. of a scientific character under the War and Interior Departments, and under the Land Office, by the National Academy of Sciences. **78,** iii, 1653.

Letter to the president of the academy. **78,** iii, 1661.

MISC. 154. SURVEYS — INSTRUMENTS ISSUED, MAPPINGS, ETC.

(See Misc. 85–96 on p. 2040 of this index.)

ENGINEERS.

In charge. Maj. O. M. Poe (Bvt. Brig. Gen. and Col., A. D. C.). **R., 75,** ii, 1109; **76,** i, 122; iii, 563; **81,** 2811 (progress of railroads in Texas-Mexico); **82,** 2825.

MISC. 155. LAKE ERIE—SHOALS IN.

ENGINEERS.

Chief of Engineers. R., 92, 420; 93, 484; 97, 547.

In charge:

Maj. A. Stickney. R., 92, 3424.

Col. J. A. Smith. R., 97, 4123.

Assistant. W. T. Blunt. R., 97, 4125.

MISC. 156. LAKE ERIE — WATER-LEVEL OBSERVATIONS.

ENGINEERS.

Chief of Engineers. R., 90, 530.

In charge. Maj. L. C. Livermore. R., 90, 3583.

Assistant. W. T. Blunt. 90, 3584.

MISC. 157. LAKE SUPERIOR — SURVEY OF WEST END, TO DETERMINE LOCAL VARIATION OF THE COMPASS.

APPROPRIATIONS.

1904. $900 allotted Aug. 5, 1902.

R. by Capt. C. L. Potter, Apr. 7, 1904, and Assistant Engineer J. H. Darling, including the following:

CONTENTS.

Chapter I—Outline of methods and results.

Chapter II—Vessel and instruments.

Chapter III—Deviation—method of determining.

Chapter IV—Method of reducing observations for variation.

Chapter V—Tests of accuracy of azimuth compass observations for variation.

Chapter VI—Effect of change of latitude on deviation—corrections.

Chapter VII—Location of points of observation.

Appendix A—An. change.

Appendix B—Local attraction in Duluth H.

MAPS AND DIAGRAMS.

Sheet I—Variations on w. portion of Lake Superior.

Sheet II—Variations in Superior B. and other data.

Sheet III—Variations near Stony Pt., showing local attraction.

Sheet IV—Deviation curves, 1902.

Sheet V—Deviation curves, 1903.

Sheet VI—Meridians, parallels of latitude, and lines of equal deviation.

Sheet VII—Interpolation curves for time.

Sheet VIII—Interpolation curves for latitude.

Sheet IX—Interpolation curves for declination.

Sheet X—Attraction of iron in a pier.

Sheet XI—Local attraction at Grand Marais, Minn., ashore.

04, 4132.

(See also Misc. 161 on p. 2122 of this index.)

R. by Lt. Col. G. D. Fitch, May 23, 1910.

Detailed R. by Mr. J. H. Darling, assistant engineer. 10, 2725.

Maps.

Chart. 10, 2734.

Deviation curves. 10, 2734.

MISC. 158. LAKE SUPERIOR, NORTH SHORE OF—SURVEY AND LOCATION OF DANGEROUS REEF NEAR MOUTH OF GOOSEBERRY RIVER.

ENGINEERS.

Chief of Engineers. R., 90, 530.

In charge. Maj. J. B. Quinn. R., 90, 3583.

MISC. 159. LONGITUDE—Determination of Difference of Longitude Between Detroit, Mich., and Fort Leavenworth, Kans.

(See also Misc. 161 on p. 2122 of this index.)

ENGINEERS.

In charge. Lt. E. H. Ruffner. **R., 72,** 1118.

MISC. 160. LATITUDE AND LONGITUDE — Colorado (Denver), Kansas (Forts Hays and Wallace), and California (Pueblo).

ENGINEERS.

Chief of Engineers. R., 73, 115.

In charge. Lt. E. H. Ruffner. **R., 73,** 1224, 1243.

Assistant. Prof. T. H. Safford. **R., 73**, 1243.

MISC. 161. NORTHERN AND NORTHWESTERN LAKES—CHARTS, BULLETINS, ETC.

NOTE.—The execution of the Lakes sur. which terminated in 1882 involved a great quantity of astronomic, topographic, and hydrographic work, all of which was performed with a high degree of accuracy and skill.

The result was the preparation of a series of reliable charts for lake vessels and the furnishing of a basis for works of chan. imp. upon the lakes themselves and their connecting waters.

This original series consisted of 76 charts, all of which were printed in black from copperplates.

At 1912 the chart work of the Lake Survey was covered by proj. approv. Apr. 17, 1909, printed upon page 937, R. of the Chief of Engineers for 1909. When completed, due to changes and omissions contemplated by this proj., the Lake Survey series will comprise about 104 separate charts, this number, however, being approx., as circumstances may arise in the future necessitating the retention of some of the H. charts as separate publications, instead of insets as planned 1912.

As a result of revisions, cancellations, and additions to the original series, based on the later surs., there were in force (1912) 120 Lake Survey charts, of which 1 was in black from old copperplate, 79 lithographs in colors from copperplate transfers, and 40 lithographs in colors from stone engravings.

The charts issued in colors have all depths of 18 or 21′ and less in blue, showing at a glance where vessels may proceed with safety, and are considered by vessel men much preferable to the old style printed in plain black and white. This series of colored charts is believed to constitute a distinct advance in chart constr. and printing and meets with high favor from navigators and others.

APPROPRIATIONS.

See 2124.

ENGINEERS.

Chief of Engineers. Rs., 66, 11, 20; **67,** 52; **68,** 74; **69,** 65; **70,** 85; **71,** 101; **72,** 99; **73,** 110; **74,** 120; **75,** 126; **76,** 116; **77,** 125; **78,** 139; **79,** 194; **80,** 244; **81,** 336; **83,** 340; **84,** 345; **85,** 375; **86,** 371; **87,** 343; **88,** 316; **89,** 384; **90,** 530; **91,** 445; **92,** 419; **93,** 481; **94,** 437; **95,** 492; **96,** 458; **97,** 544; **98,** 547; **99,** 633; **00,** 711.

For reports, 1901–1912, see page 2124.

The progress of operations under the proj. for chart revision approv. Apr. 17, 1909, was as follows at 1912:

	Existing series.	Final edition.
Number of charts in force June 30, 1912	120	....
Number of charts contemplated for final edition, by revision and consolidation of existing series and construction of new charts	....	111
Number of new charts or charts completely revised.	60	....
One of the number will eventually be made an inset on another chart and a second will be superseded and dropped, leaving a number of new charts or charts completely revised for final edition	....	58
Number of charts under revision	9	9
Number of charts to be revised, in whole or part, and issued as separate charts [1]	35	35
Number of charts to be revised and issued as insets	4	....
Number of charts to be dropped	12	....
Number of new charts in course of preparation	....	4
Additional new charts proposed	....	5
Total	120	111

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[1] 18 of the charts to be revised, in whole or in part, had already been revised for geographic positions and 17 others had been revised for hydrography. Including those partially revised and the new charts and the charts completely revised, the total number of the series in force, based on the standard geodetic datum, was 78, and the total number based on the standard datum for hydrography was 77, making a total of 95 charts either new, completely revised, or partially revised.

Of the entire series of Lake Survey charts there had been issued in colors—5 on July 1, 1900; 12 on July 1, 1901; 30 on July 1, 1902; 49 on July 1, 1903; 59 on July 1, 1904; 73 on July 1, 1905; 97 on July 1, 1906; 110 on July 1, 1907; 117 on July 1, 1908; 122 on July 1, 1909; 124 on July 1, 1910; 126 on July 1, 1911; and 124 on July 1, 1912, including the 5 general charts formerly published by the Hydrographic Office of the Navy and "now" published and sold by the Lake Survey office.

The reduction of the number of charts in colors from 126, June 30, 1911, to 124, June 30, 1912, is accounted for by the dropping of 5 old charts superseded by the work of revision under the chart proj., and the issuance of 3 new charts; probably more advantageous to reduce the number to 111 instead of to 104.

Up to Feb. 20, 1890, one full set of charts was issued free to each U. S. registered vessel. Any additional charts furnished such vessels and all furnished for other unofficial use were sold at the uniform price of 30¢ each; pursuant to law, since then, the charts have been sold for all private and unofficial use at prices ranging from 5¢ to 30¢ each, the price being intended in each instance to cover only the cost of paper and printing.

Charts may be purchased at the main office at Detroit, at the canal office at Sault Ste. Marie, Mich., and at the U. S. Engineer office in Buffalo.

Complete sample sets may be seen at the U. S. Engineer offices at Duluth, Milwaukee, Chicago, Grand Rapids, Cleveland, and Oswego, enabling purchasers to select exactly the charts they wish to order.

From 1882 to June 30, 1912, $43,215.24 derived from sale of charts.

During the fiscal year ending June 30, 1912, the number of charts sold by the Detroit office was 13,621, and by the Buffalo office 2,506, the aggregate sales being 16,127. The Detroit office issued 3,156 charts for official use and the Buffalo office 55, a total of 3,211.

To 1912 about 443,770 of these charts had been sold and issued for actual service.

For other Government offices various charts are printed in colors. For the Chief of Engineer's office (under app. "Maps, War Department") the following were, for example, reproduced and printed (1912): 4 H. charts and 10 different protractor variants of these charts; topographical map of northeast Virginia, in black; Petersburg and Five Forks, in colors; 3 maps illustrating the 3 days' Battle of Gettysburg, in colors; and 7 military maneuver ground maps, 4 in black and 3 in colors. An engraving on copper of 3 sheets of the military sur. of Luzon, Philippine Islands, was in progress.

The preparation and issue of the series of bulletins supplementary to the charts, relating to the R. and H. imps. and navigation of the Great Lakes, was begun in 1889 and was transferred to the office of the Lake Survey at Detroit in 1902. These bulletins are issued annually, with monthly supplements, during the season of navigation, and give the latest and fullest descriptions of progress in R. and H. imps. on the Great Lakes and their connecting waters, as well as significant results of surs. in rhose waters made under the direction of district engineer officers and of the Lake Survey. If deemed helpful, small maps showing location of new shoals, changes in important chans., localities hitherto uncharted, etc., are inserted in both bulletins and supplements.

The C. affected by the operations of the Lake Survey and depending upon the publication and constant revision of charts and bulletins is practically the entire C. of the Great Lakes. To keep pace with the needs of this rapidly growing traffic requires that the organization and plant be operated to their utmost capacity during the relatively short seasons available for field work. The greatly increased demand for lake charts and the publication by the Lake Survey of the Mercator charts of the Hydrographic Office, U. S. Navy (5 general charts of the Lakes), have materially increased the office operations.

In charge:

Maj. W. F. Raynolds (Bvt. Col.). **Rs., 66**, ii, 49; (Lt. Col.) **67**, 864; **68**, 932; **69**, 558; **70**, 600.

Maj. C. B. Comstock (Bvt. Brig. Gen.). **Rs., 71**, 1020; **72**, 1068; **73**, 1201; **74**, ii, 476; **75**, ii, 918; **76**, iii, 125; **77**, 1195; **79**, 1971; **80**, 2437; (Lt. Col.) **81**, 2801.

Capt. H. M. Adams. **Rs., 78**, 1416.

Lt. Col. O. M. Poe. **Rs., 83**, 2377; **84**, 2373; **85**, 2519; **87**, 3143; **88**, 2810; (Col.) **89**, 2865; **90**, 3588; **91**, 3927; **92**, 3407; **93**, 4343; **94**, 3315; **95**, 4159.

Lt. Col. G. J. Lydecker. **Rs., 96**, 4017; **97**, 4069; **98**, 3745; **99**, 3857; **00**, 5317.

For Engineers, 1901-12, see Northern and Northwestern Lakes—Surveys, etc.

OPERATIONS.

See Note at head of this abstract; reports of Engineers in charge above; and Misc. 162, p. 2124 of this index.

MISC. 162. NORTHERN AND NORTHWESTERN LAKES[1]— SURVEYS, ETC.

NOTE.—As early as 1816 local surs. of the Great Lakes for special purposes were made by Engineer officers, but the "Lake Survey" as a systematic work was commenced in 1841. It was diligently prosecuted thereafter until 1882, when for a time extended field operations were suspended.

The correction, printing, sale, and issue of charts has continued without cessation, the additions and corrections being largely based upon local surs. and Rs. by Engineer officers in charge of the R. and H. imps. on the lakes.

Systematic field work was resumed in 1889; since prosecuted with increased vigor.

In 1898 operations were extended to include cognate work of observing and investigating the levels of the Great Lakes and their connecting waters, with a view to their regulation in the interest of C.

The sur. proper has from the beginning been carried on under the War Department, being at first conducted by the Chief of Topographical Engineers, and by the Chief of Engineers after the consolidation of the Topographical Engineers with the Corps of Engineers.

A full account of the operations of the Lake Survey from May, 1841, to July 1, 1881, is contained in Professional Papers, Corps of Engineers, U. S. Army, No. 24, which describes in detail the methods of primary triangulation employed. An extract from this publication describing the condition of lake navigation in 1841 is printed in the An. R. of the Chief of Engineers for 1910, p. 1043.

The early operations of the Lake Survey were conducted with a view to meeting the demands of a limited navigation where the greatest draft was 12′. With the expansion of lake C., the increase in vessel dimensions, and the creation of chans. and Hs. with progressively increasing d., the Lake Survey has kept pace with the increasing demands by a corresponding extension of the scope of its operations.

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[1] Regulation of Lake Erie.—Act June 13, 1902, requested the President to invite Great Britain to join in forming an international commission (3 from the U. S. and 3 to represent Canada) to investigate and report upon the conditions and uses of the waters adjacent to the boundary lines between U. S. and Canada, upon mainten. and regulation of suitable levels, upon effect on shores of waters referred to, upon interests of navigation affected by diversions, etc., upon measures to regulate diversion, and to make recoms., etc., as shall best subserve the interests of navigation in the said waters. The commission to report upon the advisability of locating a dam at the outlet of Lake Erie, and to recom. agreement of treaty which should provide for the constr. of the dam; ests., etc.

R. dated Buffalo, N. Y., Jan. 8, 1910.

Members of the commission: Brig. Gen. O. H. Ernst, George Clinton, and E. E. Haskell. Canadians: Geo. C. Gibbons (chairman) and Wm. J. Stewart. Secretary, W. Edward Wilson (American section).

From a study of a large mass of data apparent that regulation of Lake Erie within a range of 1′ impracticable, between limits of 573.7 and 574.7. Some notable low levels could have been raised by some regulation. In considering measures for the latter, after weighing the advantages and disadvantages, the commission expressed the opinion "that the advantages are not of such overwhelming character as to justify the two Governments in entering upon that vexatious question, and we therefore recom. that the 'regulation' of Lake Erie be not undertaken, meaning thereby the most complete practicable regulation such as can be secured by a dam and sluice gates located at or near Buffalo."

"Compensating" works, as opposed to "regulating" works suggested for raising the level of Lake Erie "sufficiently to compensate for the damages heretofore inflicted by the Chicago Drainage Canal and other deteriorating influences." Believed that somewhere in the Niagara R. between Lake Erie and the Falls a submerged dam might be placed for the purpose. Surs. in progress to determine exact location.

Discussion of the regulation of Lake Superior, of Lake Michigan-Huron, and Lake Ontario. "If the level of a lake has been lowered, whether by diversion through the Chicago Drainage Canal or by enlargement of the outlet, the remedy seems to lie in 'compensating' rather than in 'regulating' works."

Discussion of the use of Lake Superior as a reservoir, proposed "by persons not familiar with the Great Lakes," to compensate for the diversion of water through the Chicago Drainage Canal. "It is not in the power of man to improve this uniformity of flow (of Lake Superior) to any important degree." Disturbing it would seriously affect levels in lakes below.

Contents: Great Lakes—Areas and watersheds—Water-level records—Equation for stream flow—Discharge, St. Marys R.—Discharge, St. Clair R.—Discharge, Detroit R.—Discharge, Niagara R.—Discharge, St. Lawrence R.—Discharge increments of the R. outlets of the Great Lakes system—Supply factors of the Great Lakes—Regulation of Lake Erie as proposed by the U. S. BE. on Deep Waterways—Practical regulation of Lake Erie bet. stages 573.7 and 574.7, 1903 levels—Effect of regulation of Lake Erie bet. stages 573.7 and 574.7 on water levels of Lake Ontario and St. Lawrence Canals—Practical regulation of Lake Erie bet. stages 572.0 and 574.5, 1903 levels—Effect of regulation of Lake Erie bet. stages 572.0 and 574.5, on water levels of Lake Ontario and St. Lawrence Canals—Effect of regulation of Lake Erie bet. stages 572.0 and 574.5, on water levels of Niagara R.—Effect of regulation on Lake Erie bet. stages 572.0 and 574.5, on water levels of Lake St. Clair, Lake Michigan-Huron, and connecting waters—Regulation of Lake Superior—Diversion of water through Chicago Drainage Canal, the effect of diversion on Lakes Michigan-Huron, Erie, and Ontario, and the regulation of Lake Superior to compensate for the diversion at Chicago—Regulation of Lake Michigan-Huron—Regulation of Lake Ontario—Compensating works in the Niagara R.—Tables and Plates, pages 63 to 158.

R. published as H. D. 779, 61st, 2d.

The highest attainable standards of accuracy and excellence have characterized the work from the beginning, and the work now in progress under present approv. projs. is merely an extension of the earlier work to limits which were not anticipated by the most sanguine spirits of former days.

The present general proj. of the Lake Survey (see details in the an. R. for 1907, pp. 844 to 850) proposes the ascertainment and chartering of lake d. in all significant regions of the Great Lakes to a plane 30′ below the adopted l.-w. datum of the open lakes and 25′ below the corresponding datum in the chans. of the connecting Rs., together with the completion of the related operations of triangulation and precise leveling still needed to control properly the areas under sur.

In addition, the general proj. provides for the extension of R. discharge measurements, for investigations of lake levels, and for magnetic surs. in and near main vessel courses, while prompt ex. of areas where obstrs. to navigation have been reported will be continued as heretofore.

The water area charted is about 95,000 sq. m., of which about two-thirds is on the American side of the international boundary. The shore line is about 8,345 m. in length, and of this the American line is 4,700 m. As a basis of comparison, the total shore line of the Atlantic, Pacific, and Mexican seaboards of the U. S., excluding Alaska and all islands, is stated in S. D. 74, 53d, 2d, to be 5,705 m. long.

The work of the sur. has not been limited by the national boundary, as the predomnance of the navigation interests of the U. S., amounting to 95% of the C. of the Great Lakes, has warranted surs. extending to those parts of the main traveled vessel tracks passing through Canadian waters. Canadian shore line has also been sur. where the delineation of these shores is essential to the integrity of navigation charts, as along Rs. and where vessel courses lay close to Canadian territory.

The scope of operations was enlarged by the act of Congress approv. Mar. 4, 1911, wherein it was provided that the sur. of the northern and northwestern lakes should be extended to include the natural navigable waters of the New York canals.

After the completion of the proj., the mainten. of a small equipment and organization will be required for such minor surs. as may be needed to observe and verify natural changes and to investigate wrecks and other artificial obstrs. and to keep up the revision and issue of charts.

The state of the field work of the Lake Survey on the Great Lakes and connecting Rs., which includes operations of triangulation, topography, precise leveling, ordinary sounding, deep-sea sounding, sweeping, hydraulic measurement, and magnetic observations, was est., June 30, 1912, to be as follows: Triangulation, 85% completed; topography, 70% completed; precise leveling, 64% completed; ordinary sounding, 62%, and deep-sea sounding, 15%; sweeping, 51%; hydraulic measurement, 94%; and magnetic observations, 94% completed on land and 35% on water.

While progress toward completion of these branches of the work may thus be definitely stated, the issue of charts, perhaps the most important duty of the Lake Survey, is a continuous function, increasing in importance with the growth of the lake C. and subject to constantly increasing demands.

APPROPRIATIONS.

Surveys:

Mar. 3, 1841	$15,000
May 18, 1842	20,000
Mar. 1, 1843	30,000
June 17, 1844	20,000
Mar. 3, 1845	20,000
Aug. 8, 1846	25,000
Aug. 12, 1848	25,000
Mar. 3, 1849	10,000
Sept. 28, 1850	25,000
Mar. 3, 1851	25,000
Aug. 30, 1852	25,000
Mar. 3, 1853	50,000
Aug. 5, 1854	50,000
Mar. 3, 1855	50,000
Aug. 30, 1856	50,000
Mar. 3, 1857	50,000
June 12, 1858	75,000
Mar. 3, 1859	75,000
June 21, 1860	75,000
Mar. 2, 1861	75,000
July 5, 1862	105,000
Feb. 9, 1863	106,879
July 2, 1864	100,000
Feb. 28, 1865	125,000
June 12, 1866	50,000
Mar. 2, 1867	77,500
Mar. 2, 1868	77,500
July 20, 1868	75,000
Mar. 3, 1869	100,000
July 15, 1870	100,000
Mar. 3, 1871	175,000
June 10, 1872	175,000
Mar. 3, 1873	175,000
June 23, 1874	175,000
Mar. 3, 1875	150,000
July 31, 1876 (not including $16,000 applied to sur. of Mississippi R.)	84,000
Mar. 3, 1877 (not including $25,000 applied to sur. of Mississippi R. and including $9,500 received from sale of steamers)	94,500
June 20, 1878 (not including $49,500 applied to sur. of Mississippi R.)	49,500
Mar. 3, 1879	85,000
June 16, 1880	40,000
Mar. 3, 1881	18,000
Aug. 7, 1882	12,000
Total	$2,939,879

Charts for use of navigators, printing and issue of; and electrotyping copper-plates for chart printing:

Mar. 3, 1883	$3,000	
July 7, 1884	3,000	
Mar. 3, 1885	3,000	
Aug. 4, 1886	2,000	
Mar. 3, 1887	2,000	
Oct. 2, 1888	2,000	
Mar. 2, 1889	2,000	
Aug. 30, 1890	2,000	
Mar. 3, 1891	2,000	
Aug. 5, 1892	2,000	
Mar. 3, 1893	2,000	
Aug. 18, 1894	2,000	
Mar. 2, 1895	2,000	
June 11, 1896	2,000	
June 4, 1897	2,000	
July 1, 1898	3,000	
Mar. 3, 1899	3,000	
June 6, 1900	3,000	
Total		42,000

Surveys, and additions to and correcting engraved plates.

Mar. 2, 1889	$5,000	
Aug. 30, 1890	10,000	
Mar. 3, 1891	10,000	
Aug. 5, 1892	5,000	
Mar. 3, 1893	25,000	
Aug. 18, 1894	25,000	
Mar. 2, 1895	25,000	
June 11, 1896	25,000	
June 4, 1897	25,000	
July 1, 1898	25,000	
Mar. 3, 1899	25,000	
June 6, 1900	75,000	
Total		280,000

Surveys, including investigations of lake levels, correcting, printing, and issuing charts and bulletins:

Mar. 3, 1901	$100,000	
June 28, 1902	150,000	
Mar. 3, 1903	150,000	
Apr. 28, 1904	150,000	
Mar. 3, 1905	100,000	
June 30, 1906	75,000	
Mar. 4, 1907	75,000	
May 27, 1908	125,000	
Mar. 4, 1909	125,000	
June 25, 1910	125,000	
Mar. 4, 1911	125,000	
Total		1,300,000
Grand total (**12**, 3549)		4,561,879

ENGINEERS.

Chief of Engineers. **R.**, **66**, ii, 20; **67**, 52; **68**, 74; **69**, 65; **70**, 85; **71**, 101; **72**, 99; **73**, 110; **74**, 120; **75**, 126; **76**, 116; **77**, 125; **78**, 139; **79**, 184; **80**, 244; **81**, 336; **82**, 325; **83**, 340; **84**, 345; **85**, 375; **86**, 371; **87**, 343; **88**, 316; **89**, 384; **90**, 350; **91**, 445; **92**, 419; **93**, 481; **94**, 437; **95**, 492; **96**, 438, 439, 440, 441; **97**, 544; **98**, 547; **99**, 633, 637; **00**, 711; **01** 677; **02**, 598; **03**, 660; **04**, 732; **05**, 739; **06**, 821; **07**, 842; **08**, 887; **09**, 931; **10**, 1043; **11**, 1105; **12**, 1322.

In charge:

Maj. W. F. Raynolds. **R.**, **66**, ii, 43; (Lt. Col.) **67**, 553; **68**, 925; **69**, 549; **70**, 535.

Maj. C. B. Comstock. **R.**, **70**, 614; **71**, 982, 991; **72**, 1031, 1035, 1040, 1042; **73**, 1169, 1175, 1178; **74**, ii, 402, 444; **75**, ii, 852, 857; **76**, iii, 3, 126; **77**, 1105, 1110, 1128; **79**, iii, 1891; **80**, 2365; (Lt. Col.) **81**, 2781, 2789; **82**, 2785.

Measurement of Minnesota Pt. base. **71**, 982, 991.

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Irregular oscillations in surface of Lake Michigan at Milwaukee. **72**, 1040.

Adjustment of a triangulation where angles, not directions, are the data, and where there is a single measured base. **72**, 1042.

Adjustment by least squares of triangles connecting Minnesota Pt. and Keweenaw base in Lake Superior. **73**, 1175.

Note on the probable error of latitude determinations with zenith telescope. **73**, 1178.

Length of Keweenaw base. **74**, ii, 444; **77**, 1128.

Memoranda respecting Lake Sur. **75**, ii, 857.

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SURVEYS, EUROPEAN.

Notes on, compiled under the direction of Maj. C. B. Comstock. Oct. 9, 1876. Lake Survey Office. Contents **76**, iii, 126.

British Surveys.—Methods and processes of ordnance surveys, compiled by Capt. H. M. Adams, Corps of Engineers, U. S. Army.

Notes compiled by Lt. P. M. Price, Corps of Engineers, U. S. Army. With ordnance survey maps.

German Surveys.—Notes compiled by Maj. Comstock and Lt. P. M. Price.

State Geological Institute. Translated by F. W. Lehnartz.

Geological map of Prussia and the Thuringian States. Translated by F. W. Lehnartz.

Instructions for royal State geologists. Translated by F. W. Lehnartz.

Austrian Surveys.—Memoir furnished by Austrian Government. Translated by F. W. Lehnartz.

Italian Surveys.—Italian chartography.

Notes by Capt. H. M. Adams, Corps of Engineers, U. S. Army., on Italian maps.

Spanish Surveys.—Translation of description of, by Lt. P. M. Price.

Swiss Surveys.—Notes compiled by Lt. P. M. Price.

Swedish and Norwegian Surveys.—Statistics relating to geodetical and topographical work. Translated by Mr. Liljencrantz.

Notes on maps of Sweden, by Lt. P. M. Price.

Notes on maps of Norway, by Lt. P. M. Price.

Belgian Surveys.—Notes on topographical map of Belgium, by Capt. H. M. Adams.

Russian Surveys.—Notes on, by Maj. Comstock.

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Maj. W. L. Fisk. R., 01, 3761; 02, 2763; 03, 2671; 04, 4051.

Maj. L. H. Beach. R., 05, 2775.

Col. G. J. Lydecker. R., 06, 2241.

Maj. C. Keller. R., 07, 2443; 08, 2511; 09, 2477.

Maj. C. S. Riche. R., 10, 2701; (Lt. Col.) 11, 3005; 12, 3529.

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See also "Special Reports," p. 2128 of this index.

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D. Molitor. **R.** Resur., St. Marys R. **94,** 3422.

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J. H. Darling. R. (See p. 2129.)

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Maj. C. Keller. R.

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ENGINEERS.

Chief of Engineers. R., 70, 86; 93, 484.

In charge:

Maj. H. L. Abbot (Bvt. Brig. Gen.). Criticism of Assistant Engineer Henry's gauging observations. 70, 616, 620.

Maj. E. H. Ruffner. R., 93, 4364.

MISC. 164. NORTHERN AND NORTHWESTERN LAKES—VALLEY OF, OUTFLOW, RAINFALL, AND EVAPORATION.

ENGINEERS.

Chief of Engineers. **03**, 665.

In charge. Maj. W. H. Bixby. **03**, 2855.

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MISC. 165. NORTHERN AND NORTHWESTERN LAKES—WATER LEVELS.

(See Misc. 121, 156, 161–164 on pp. 2106, 2121, 2122–2132 of this index.)

NOTE.—In addition to the field work of the Lake Survey, operations have been continued under the general proj. for the exhaustive investigation of lake levels, in continuation and extension of the proj. outlined in the an. R. for 1898, pp. 3774–3776. This work comprises lake temperature observations and the mainten. of a staff and self-registering gauges to supply accurate, continuous records of all changes in elevation of the water surfaces on the lakes and Rs. **12**, 1327.

For table of discharges for all of the Great Lakes at the mean stage of each for the past 52 years as determined by the standard gauges see **12**, 3544.

This work is now fully organized, methods of making measurements and observations to the best advantage have become fixed and settled, and the results are of increasing importance, bearing, as they do, on questions affecting international relations and obligations, and on the propriety and advisability of the numerous diversions under consideration.

APPROPRIATIONS.

See page 2125 of this Index.

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See each an. R. from 1873 to 1912, inclusive.

ENGINEERS.

Chief of Engineers. R., **88**, 316; **92**, 422; **93**, 486; **94**, 441; **95**, 497; **96**, 442; **97**, 547; **98**, 551; **99**, 637; **00**, 715; **01**, 681; **02**, 602; **03**, 665; **04**, 736; **05**, 743; **06**, 825; **07**, 854; **08**, 893; **09**, 939; **10**, 1050; **11**, 1105; **12**, 1322.

In charge:

Col. O. M. Poe. R., **88**, 2807; **92**, 3429; **93**, 4381; **94**, 3319, 3430; **95**, 4159, 4251.

Lt. Col. G. J. Lydecker. R., **96**, 4067; **97**, 4127; **98**, 3779; **99**, 3851; **00**, 5319, 5402.

Capt. D. C. Kingman. R. (Lake Ontario), **93**, 4382; **94**, 3436.

Maj. J. F. Gregory. R. (Lake Michigan), **93**, 4383; **94**, 3435.

Capt. S. S. Leach. R. (Ogdensburg), **93**, 4384.

W. T. Blunt. R. (Lake Erie), **94**, 3431.

Capt. G. A. Zinn. R. (Lake Michigan), **96**, 4071; **97**, 4129; **98**, 3781.

Maj. W. S. Stanton. R. (Lake Ontario), **96**, 4068; **97**, 4128; **98**, 3780.

Capt. G. D. Fitch. R. (Lake Ontario), **99**, 3862.

Lt. Col. J. A. Smith. R. (Lake Erie), **94**, 3431; **96**, 4068; (Col.) **97**, 4128; **98**, 3780; **99**, 3861.

Capt. J. G. Warren. R. (Lake Michigan), **99**, 3860.

Maj. C. B. Sears. R. (Lake Superior), **96**. 4070; **97**, 4129; **98**, 3781; **99**, 3860.

Maj. W. L. Fisk. R., **01**, 3776; **02**, 3032; **03**, 2671; **04**, 4051.

Maj. L. H. Beach. R., **05**, 2782.

Col. G. J. Lydecker. R., **06**, 2249.

Maj. C. Keller. R., **07**, 2455; **08**, 2511, 2534; **09**, 2477, 2500; **10**, 2701, 2719.

Lt. Col. C. S. Riché. R., **11**, 3019; **12**, 3544.

Assistants:

W. H. Hearding. R., **93**, 4384.

Wm. T. Blunt. R. (Lake Michigan), **94**, 3431.

Lt. C. H. McKinstry. R. (Lake Michigan), **94**, 3435.

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OPERATIONS.

See Note at beginning of this abstract; also each an. R. for detailed tables, etc.; "Engineers," above; and p. 2124.

MISC. 166. LAKE MICHIGAN — REEF SOUTH OF MANITOWOC, WIS.

ENGINEERS.

Chief of Engineers. 03, 665.

In charge. 03, 2883.

Steamer *Tuscarora* reported striking reef; d. of water not over 13 or 14′; ex. made; R. submitted sur. made, showing locations and soundings thereon, submitted Apr. 13, 1903. 03, 2883.

MISC. 167. LAKE MICHIGAN—REEF OFF WIND POINT, NEAR RACINE HARBOR, WIS.

ENGINEERS.

Chief of Engineers. 03, 665.

In charge. Maj. J. G. Warren. 03, 2883.

OPERATIONS.

1902–03. Reef located and plainly marked. Sur. in progress. 03, 665, 2883.

1903–04. Inset of sur. published in colors in Supplement No. 4, of Bulletin No. 13, Northern and Northwestern Lakes. 04, 737, 4051.

MISC. 168. UNITED STATES ARMY—EQUIPMENT OF COAST ARTILLERY, ARMORIES, ORGANIZED MILITIA.

The Army app. act approv. Mar. 3, 1911, provided the sum of $338,170 for the equipment of armory buildings provided by States for instructional purposes for Coast Artillery companies of the Organized Militia. With these funds equipments installed for the instruction of Coast Artillery militia at the following places:

- Boston, Mass., South Armory.
- Bridgeport, Conn.
- New York City:
  - Ninth District Armory.
  - Thirteenth District Armory.
- Savannah, Ga.
- San Francisco, Cal.

For the work required of the Engineer Department in this connection the sum of $105,426.56 assigned to this department for expend. by the Sec. of War. At the close of 1911-12 the Engineer work at the Boston Armory had been completed so far as possible pending the arrival of the armament and other equipment, and the work remaining to be done at this armory and the necessary work at the other armories had been placed under contract.

By the Army app. act of Aug. 24, 1912, the availability of this app. was extended to include obligations incurred during the fiscal year ending June 30, 1913. 12, 20.

MISC. 169. EQUIPMENT, ENGINEER — EQUIPMENT OF OFFICERS' SCHOOLS, MILITARY POSTS.

For the purchase of instruments for issue to officers' schools at military posts the sum of $3,000 was assigned from the app. for "Equipment of officers' schools, military posts, 1912," by the Sec. of War. This amount applied to purchase of instruments for issue from the Engineer depot at Washington Barracks. For similar purchases during 1912-13 the sum of $1,500 assigned to the Engineer Department. 12, 26.

MISC. 170. PHILIPPINES—MILITARY STRUCTURES.

The constr. of a pumping plant, electric power plant, and certain Army storehouses for military purposes in the Philippine Islds. assigned to the Engineer Department; funds from various appa. applied thereto; funds insufficient; est. addl. sum of $170,000 required. 12, 23.

MISC. 171. RESERVATIONS — GOVERNORS ISLAND, NEW YORK HARBOR, ENLARGEMENT OF.

(See New York Harbor, N. Y., on p. 283 of this index; also p. 1881.)

APPROPRIATIONS.

1901,	$200,000,	**01**, 1298.
1902,	200,000,	**02**, 981.
1903,	150,000,	**03**, 923.
1904,	200,000,	**04**, 133, 1126.
1905,	100,000,	**05**, 1023.
1907,	100,000,	**07**, 1039.
1908,	75,000,	**08**, 1086.
1909,	75,000,	**09**, 1098.

Total, 1,100,000 (incl. misc., $1,100,002.60, **12**, 1512).

CONTRACTS.

1901. R. G. Packard, dr. 89,750 c. y., 78¢ c. y.; Rosevelt & Sullivan, building pile dock; approx. cost, $25,362.16; Brown & Fleming, building riprap bulkhead, 142,000 t. st., 35¢ t. **02**, 981.

1902. New York Filling Co., building embankment; R. G. Packard Co., removal of r. **03**, 924.

1903. J. D. Miller, building riprap bulkhead. **03**, 924.

1904. Humphrey Toomey, building st. sea wall. **05**, 1023.

1905. Brown & Fleming Contracting Co., building st. sea wall (2d contract), $20.25 l. f. **06**, 991.

1907. Henry Steers (Inc.), building embankment; inner section, 17¢, and outer section, 22.6¢ c. y. **08**, 1086.

1909. Henry Steers (Inc.), building embankment and sea wall, $70,400. **10**, 1222.

1910. Henry Steers (Inc.), furnishing and spreading and fertilizing material on new embankment and seeding same, $89,400. **10**, 1223.

1911. Henry Steers (Inc.), supple., increased quantity of earth under contract of Jan. 5, 1910, from 102,850 c. y. to 140,000 c. y. **11**, 1298.

ENGINEERS.

Chief of Engineers. **R.**, **01**, 228; **02**, 150; **03**; 144; **04**, 133; **05**, 139; **06**, 145; **07**, 153; **08**, 160, **09**, 163; **10**, 186; **11**, 192; **12**, 232.

In charge:

Maj. W. L. Marshall, 1901-08. **R.**, **01**, 1298; **02**, 969; **03**, 920; (Lt. Col.) **04**, 1124; **05**, 1021; **06**, 989; **07**, 1037; **08**, 1084.

Col. S. W. Roessler, 1909. **R.**, **09**, 1097; **10**, 1221; **11**, 1296; **12**, 1510.

LEGAL PROCEEDINGS.

Land conveyed to U. S. by State of New York, to be covered by bulkhead as orig. designed; extension of bulkhead can not be built until grant of land is correspondingly extended. **02**, 980. State of New York, Mar. 6, 1903, au. the issue to U. S. of a further grant of land under water, to admit extension of isld. Letters patent granted June 5, 1903. **03**, 921.

OBSTRUCTIONS.

Sea wall ran into by ferryboat; damage to. **11**, 1297. Sea wall (1912) again run into about ¾ m. from Castle Williams. **12**, 1511.

OPERATIONS.

1901-02. Pile wharf: Work begun and nearly completed; in daily use by Quartermaster Department, which laid track along wharf to connect with large warehouse; 8 iron mooring posts and cleats purchased and placed. **02**, 979. Dr. in front of wharf: 69,944 c. y. sand, gravel, clay, and bowlders dr. **02**, 979. Riprap bulkhead: 2,430 l. f. completed and 750′ in progress; se. wall along Buttermilk Chan., 2,230′ l., completed up to 2′ above l. w., and sw. or cross wall begun; operations suspended to admit of completion of arrangements for further extension of proposed enlargement as per plans of McKim, Mead & White, architects. **02**, 980. Engineer landing: Small dock near Castle Williams extended to 9½′ d., m. l. w., with landing face of 51′; area in front dr. to 15′, m. l. w.; during dr. 3 submarine mine cables were picked up by the dr., and were repaired and relaid without cost to U. S. **02**, 980–81.

1902–03. Pile wharf: Dock completed Aug. 6, 1902; measurements given. **03**, 920, 921. Dr. in front of wharf: 606 c. y. removed; 19 c. y. bowlders removed; work completed. **03**, 920. Riprap bulkhead: 89,079 t. riprap delivered; the pile platform carrying light and fog bell near outer end of nw. bulkhead run into by car float and wrecked beyond repair; a small schooner hired and anchored near end of bulkhead for carrying light and fog bell. **03**, 921.

Two intercepting sewers built for removal of sewage, discharging, respectively, into Buttermilk Chan. and North R. current near Castle Williams. **03**, 922.

Embankment behind bulkhead: 836,668 c. y. material placed, of which 46,985 c. y. above l.-w. level; area above l. w. a strip along North R. bulkhead about 1,700′ l. and from 40′–150′ w. **03**, 922.

1903–04. Removal of ledge in front of new wharf: R. shattered by blasting and removed by dr., making 26′, m. l. w., at approaches; 35 c. y. r. removed. **04**, 1124. Riprap bulkhead: 123,233 t. riprap delivered; bulkhead w. of gap, 1,068′, completed, and part e. of gap in progress; total l. of bulkhead completed, 1,366′. **04**, 1125. Embankment behind bulkhead: 745,878 c. y. material delivered; difficulty experienced in building up above l. w. **04**, 1125. Masonry sea wall: Tests made to ascertain whether riprap embankment would support masonry sea wall. **04**, 1125.

1904–05. Riprap bulkhead: 45,933 t. riprap placed, building 629 l. f. of work; gap about 352′ wide left at s. end, to admit scows bringing materials for embankment; total l. of completed bulkhead, 6,795′. **05**, 1021. Embankment behind bulkhead: 105,792 c. y. material placed; total material in embankment above l. w., 185,082 c. y. **05**, 1021, 1022. Masonry sea wall: Buttermilk Chan. side of inclosure completed; work begun on North R. side of Castle Williams wall; total l. of wall, 2,195′ at coping and 2,681′ at foundation. **05**, 1022.

1905–06. Embankment: 343,325 c. y. sand and cinders brought behind bulkhead, 203,504 c. y. of said total pumped up above l.-w. level; area inclosed by bulkhead built above low tide for 800′ beyond old sea wall, an area of 37 acres, 20 acres above ordinary h. w. **06**, 989. Masonry sea wall: 2,210′ sea wall built; 2,514 t. riprap added to bulkhead to protect it against undermining. **06**, 989.

1906–07. Embankment: 65,399 c. y. material, mainly sand, delivered and dumped within inclosed area; 43,650 c. y. filling pumped into embankment at m. l. w.; contractor claimed that full amount of filling had been delivered and contract was completed, notwithstanding embankmust be built up to certain grades; contractor refused to continue work; with sanction of Chief of Engineers, contract annulled June 8, 1907, and proposals for further constr. invited. **07**, 1037. Masonry sea wall: Extended 1,982′, making total l. 6,757′; in March sea wall was run into on Buttermilk Chan. side, about 2,000′ from orig. isld. **07**, 1038. Office building on sea wall destroyed by lightning, replaced. **07**, 1038.

1907–08. Embankment: 1,181,225 c. y. material delivered, of which 597,750 c. y. placed above l. w., 295,565 c. y. in the inner section, and 302,185 c. y. in the outer section; about 32 acres of embankment built up to required grade, 27 acres of which are in the inner section. **08**, 1084. Masonry sea wall: The sea wall on the Buttermilk Chan. side run into by a steamer on night of Jan. 23–24, damaging wall for l. of 16′ at bottom, and 124′ or more at coping; repairs made to wall. **08**, 1084. Light and fog bell maintained. **08**, 1085.

1908–09. 1,124,388 c. y. material brought into inclosure, of which about 1,000,000 c. y. was from sand dr. in H. and rest from street and cellar excavations in the city; material pumped overboard into embankment behind temporary bulkhead to retain embankment; of total, 638,339 c. y., prism measurement, placed above m. l. w.; 22,216 t. riprap placed along base of sea wall, covering section of 3,200′ along Hudson R. side and 2,000′ along Buttermilk Chan. side, where erosion and yielding affected foundation of wall. **09**, 1097–98.

1909–10. 151,406 c. y. embankment above l. w. placed; area built up to approx. grade, about 8¼ acres; 2,819 c. y. soil placed in line to grade up for R. R. track to be used in spreading the soil. **10**, 1221–22.

1910–11. 155,363 c. y., prism measurement, delivered and place above plane of m. l. w., adding 8.2 acres to area filled; 16,964 t. riprap placed in foundation for sea wall; constr. of masonry wall on this foundation progressed for l. of about 103 l. f.; 117,931 c. y., prism measurement, of surface earth placed and graded, covering area of 63 acres, 41 acres of which have been fertilized, harrowed, seeded, and rolled. **11**, 1297.

1911–12. Sea wall and embankment finished; 172,983 c. y. filling delivered; amount placed above l.-w. plane, 80,538 c. y., prism measurement; contractor built 358 l. f. sea wall, closing gap; 18,148 c. y. surface earth placed, delivered, and harrowed in 4,664 c. y. fertilizer, and seeded down 38 acres, damage to sea wall caused by ferryboat *Nassau* repaired; the light and fog bell, maintained by Engineer Department since beginning of operations, transferred to Lighthouse Department, with small building and other appliances, May 10, 1912. **12**, 1510, 1511.

PHYSICAL CHARACTERISTICS.

Condition of work. **05**, 1022; **07**, 1038.

Settling of masonry sea wall. **06**, 989; **07**, 1037; **12**, 1511.

85 acres land built up to grade. **09**, 1098.

Sea wall and embankment completed; area inclosed about 100 acres. **12**, 1511.

PROJECTS.

Sundry civil act Mar. 3, 1901, au. enlargement in accordance with plan by board of officers, Aug. 17, 1900, including constr. of dock, and dr. chan.; est., $215,000; constr. of bulkhead and filling; est., $885,000. **01**, 228.

Proj. modified Aug. 22, 1901, substituting riprap bulkhead, built to about 2′ above m. l. w., for crib bulkhead, on account of bottom being too soft to support cribwork; further modification to provide for extending and repairing old Engineer

landing near Castle Williams, for landing Quartermaster stores, etc., and saving rental of storehouses; to provide d. of 15′, m. l. w., at that landing by dr. Again modified, Apr 14, 1902, to defer erection of steel shed or cover upon wharf, and to apply funds intended for same to continuing bulkhead for enlargement of isld. **02**, 979.

Plan for expend. of $200,000 submitted June 14, 1901; au. by Sec. of War July 5, 1901, viz: Constr. of pile dock and covered wharf on n. shore to communicate with proposed Quartermaster storehouse, $65,000; excavation of chan. 26′ over shoal and exterior and adjacent to dock and wharf, $75,000; building crib bulkhead, w. side of Buttermilk Chan., as part of sea wall supporting enlargement of isld. over s. shoal. **02**, 979.

The orig. plan for reclaiming 82 acres of land was extended to 101 acres by au. of Sec. of War; no increase in cost. **03**, 144.

At 1912, est. $15,000 required in next 3 years to care for probable settlement of wall and embankment. **12**, 233.

SURVEYS.

Congressional documents, etc., relating to exs., surs., plans, etc. **12**, 233.

MAP. 03, 922.

PART IV.

SPECIAL SUBJECTS.

REPORTS, CHIEF OF ENGINEERS, UNITED STATES ARMY, 1866–1912.

Section 1. SUPERVISION OF BRIDGE CONSTRUCTION, ETC.
Section 2. SUPERVISION OF STRUCTURES OTHER THAN BRIDGES IN CONNECTION WITH NAVIGABLE WATERS.
Section 3. ESTABLISHMENT OF HARBOR LINES.
Section 4. WRECK REMOVALS.
Section 5. SUMMARY OF RIVER AND HARBOR APPROPRIATIONS.
Section 6. ALPHABETICAL LIST OF ENGINEERS IN DIRECT CHARGE OF RIVER AND HARBOR IMPROVEMENTS.
Section 7. ALPHABETICAL LIST OF CONTRACTORS ON RIVER AND HARBOR WORKS.
Section 8. INDEX TO LAWS AFFECTING THE CORPS OF ENGINEERS.
Section 9. CLASSIFIED LIST OF FLOATING PLANT.

SPECIAL SUBJECTS.

Reports, Chief of Engineers, 1866-1912.

SECTION 1.—SUPERVISION OF BRIDGE CONSTRUCTION.

NOTE.—The bridges referred to in this section are indexed under the name of the stream or harbor they cross.

The letter or letters in parentheses after each title are symbols or abbreviations having the following meaning:

A., alterations. O., navigation obstructed; alterations required within a specified time. S., bridge erected under State laws, or altered under them. Sp., erected under special act of Congress. Dr., rules prescribed for opening drawbridges.

A.

ACOAKSETT R., Westport Pt., Mass. (S.) (Westport town br.) Reconstr., approv. Apr. 22, 1904. **04,** 718.

ACUSHNET R., between New Bedford and Fairhaven, Mass. (S.) (Bristol County br.) PLANS.—Reconstr. plans partly (from Fairhaven to Popes Isld.) approv. June 23, 1896, pending results of sur. au. act June 3, 1896, **96,** 426. Modified plans approv. Sept. 23, 1896; constr. plans (second part between Popes and Fish Islds.) approv. July 17, 1897, **97,** 532.

ACUSHNET R., between Popes and Fish Islds., New Bedford H., Mass. (S.) (Union Street Ry. Co.) **97,** 535. PLANS.—Plans for a temporary br. during reconstr. of county br. between Popes and Fish Islds., approv. (revocable permit) Aug. 20, 1897, **97,** 535.

ACUSHNET R., New Bedford to Fish Isld., Mass. (S.) (City br.) PLANS.—Reconstr., including temporary str., approv. Mar. 8, 1901, **01,** 665.

ADAMS CREEK, Winthrop, N. C. (See Smiths Creek.)

AHNAPEE R., Algoma, Wis. (S.) (City br.) PLANS.—Approv. Apr. 11, 1899, **99,** 622.

ALABAMA R., near Montgomery, Ala. (Sp.) (Mobile & Ohio R. R. Co., successors to the Montgomery, Tuscaloosa & Memphis Ry. Co., formerly the Alabama Great Northwestern Ry. Co.) LEGISLATION.—Original company au. to constr. br. by act Aug. 6, 1888, **90,** 336. Act June 11, 1896, this franchise granted to the Mobile & Ohio R. R. Co., **97,** 530. PLANS.—Original company's plans approv. Aug. 5, 1889, **90,** 336. Plans, June 10, 1897, for a different location, approv. June 16, 1897, **97,** 530.

ALABAMA R., near Montgomery, Ala. (Sp.) (Montgomery Br. Co.) LEGISLATION.—Company au. to constr. br. act Mar. 1, 1893, **94,** 425. PLANS.—Submitted Feb. 8, 1894; modified Feb. 23, 1894; approv. Mar. 27, 1894, **94,** 425.

ALABAMA R., Montgomery, Ala. (S.) (Montgomery Br. & Improvement Co.) PLANS.—Approv. Jan. 18, 1904, **04,** 716.

ALABAMA R., Selma, Ala. (A.) ENGINEERS.—BE. Br. considered obstr. to navigation; recom. that the br. company prepare a chan. between pivot span and n. bank for passage of boats at all stages exceeding a 24′ stage, and provide such future facilities to navigation as might be required, **86,** 2136. PLANS.—It having been represented that the br. was likely to create an obstr., BE. convened in 1886 to consider and R., **86,** 370, 2136; **88,** 309.

ALABAMA R., Selma, Ala. (S.) (Louisville & Nashville R. R. Co.) PLANS.—Approv. Feb. 7, 1901, **01,** 665.

ALAFIA R., Riverview, Fla. (S.) (Hillsboro County br.) PLANS.—Approv. Jan. 16, 1901, **01,** 664.

ALBEMARLE SOUND, between Hornblower Pt. and Mackeys Creek, N. C. (S.) (Norfolk & Southern Ry. Co.) PLANS.—Modified plans approv. June 23, 1909, **09,** 918.

ALBEMARLE SOUND and JOHNSON and MACKEYS CREEKS, N. C. (S.) (Brs. of Norfolk & Southern R. R. Co.) PLANS.—Approv. Dec. 6, 1906, **07,** 824.

ALEQUA CREEK, near Portland, Fla. (S.) (Walton County br.) PLANS.—Approv. Aug. 11, 1897, **97,** 534.

ALGER (or Brooks) SLOUGH, Wahkiakum County, Wash. (Sp., etc.) (County br.) LEGISLATION.—County au. to constr. br. under act Sept. 19, 1890, sec 7 and act of Washington,

92, 404. PLANS.—Approv. Mar. 19, 1892. Completion of br. reported June 25, 1892, **92**, 404.

ALHAMBRA SLOUGH. (See Pacheco Slough.)

ALLEGHENY R. (See Ohio River, etc.)

ALLEGHENY R., near Bullis Mills, Pa. (S.) (Pittsburgh, Shawmut & Northern R. R. Co.) PLANS.—Approv. Apr. 13, 1909, **09**, 917.

ALLEGHENY R., Creighton, Pa. (S.) (Creighton Br. Co.) PLANS.—Approv. Feb. 27, 1894, **94**, 428.

ALLEGHENY R., at Foxburg, Pa. (S.) (Baltimore & Ohio R. R. Co.) PLANS.—False work for repair to existing br. approv. Nov. 1, 1911, **12**, 1302.

ALLEGHENY R., at Franklin, Pa. (S.) (Oil City Station Ry. Co.) PLANS.—Approv. Nov. 26, 1900, **01**, 663.

ALLEGHENY R., Franklin, Pa. (A.) (Venango County br.) PLANS.—Reconstr. approv. July 21, 1902, **03**, 651. Modified plans approv. Dec. 17, 1903, **04**, 720.

ALLEGHENY R., near Franklin, Pa. (A.) (Big Rock Br. Co., Big Rock Br.) PLANS.—Reconstr. approv. May 6, 1903, **03**, 651.

ALLEGHENY R., Freeport, Pa. (S.) (Armstrong and Westmoreland Counties' br.) PLANS.—Approv. May 6, 1896, **96**, 426.

ALLEGHENY R., Back Chan., Herr Isld., Pa. (S.) (Western Pennsylvania R. R. Co.) PLANS.—Plans of a temporary and 2 permanent brs. approv. Aug. 29, 1902, Sept. 19, 1902, and Mar. 9, 1903, respectively, **03**, 649.

ALLEGHENY R., Kennerdell, Venango County, Pa. (S.) (Venango County br.) PLANS.—Approv. Jan. 13, 1903, **03**, 647. Plans in lieu thereof approv. June 13, 1906, **06**, 808, and Sept. 13, 1906, **07**, 822.

ALLEGHENY R., Mahoning, Pa. (S.) (Pittsburgh & Shawmut R. R. Co.) PLANS.—Approv. Mar. 24, 1910, **10**, 1028.

ALLEGHENY R., near Mosgrove, Pa. (S.) (Allegheny & Western Ry. Co.) PLANS.—Modified plans approv. Feb. 23, 1898. Modified plans reducing l. of spans and changing constr. of ps. approv. May 24, 1898. **98**, 535.

ALLEGHENY R., New Kensington, Pa. (S.) (New Kensington Br. Co.) PLANS.—Modified plans approv. Apr. 8, 1898, **98**, 535.

ALLEGHENY R., New Kensington, Pa. (S.) (Tarentum Br. Co.) PLANS.—Approv. June 10, 1893, **93**, 470.

ALLEGHENY R., Oakmont and Hulton Ferry, Pa. (Sp.) (Allegheny County br.) Au. act Jan. 12, 1907. PLANS.—Approv. June 11, 1907, **07**, 819.

ALLEGHENY R., Oil City, Pa. (Sp., etc.) (Relief Br. Co.) LEGISLATION.—Company au. to constr. br. under act July 13, 1892, sec. 3, and act of Pa., **92**, 410. PLANS.—Approv. Sept. 1, 1892, **92**, 410.

ALLEGHENY R., Oil City to Franklin, Pa. (S.) (Rouseville & Franklin R. R. Co.) PLANS.—Approv. Dec. 13, 1900, **01**, 663.

ALLEGHENY R., Oil City, Pa. (S.) (Venango County br.) PLANS.—Plans of br. to replace existing str., approv. Sept. 14, 1908, **09**, 915.

ALLEGHENY R., at Pittsburgh, Pa. (S.) ENGINEERS.—Chief of Engineers. R., **75**, ii, 121. Approv. R. of Maj. Merrill, **75**, ii, 684. LEGISLATION.—Br. au. by Pa., **75**, ii, 685. PLANS.—Maj. Merrill R. br. a serious and unnecessary obstr. to navigation, **75**, ii, 687, 688. Drawspan recom., **75**, ii, 687, 688. Plan, **75**, ii, 686.

ALLEGHENY R., near Pittsburgh, Pa. (Sp.) (Pittsburgh & Butler R. R. Co.) Au. act June 11, 1896, **96**, 424. PLANS.—Approv. Aug. 18, 1896, **96**, 424.

ALLEGHENY R., Highland Park, from a point at or near Pittsburgh, Pa., to Sharpsburg, Pa. (S.) (Highland Park Br. Co.) PLANS.—Approv. Sept. 13, 1899, **00**, 699.

ALLEGHENY R., Pittsburgh (6th Street), Pa. (Sp.) (Allegheny Br. Co.) LEGISLATION.—Au. act Sept. 19, 1890, sec. 7, and act of Pa., **91**, 431. PLANS.—Approv. May 2, 1891, **91**, 431. Plans for false work, erected during progress of work, approv. Aug. 4, 1892, **92**, 408.

ALLEGHENY R., Pittsburgh to Sharpsburg, Pa. (S.) (Pittsburgh & Sharpsburg Br. Co.) PLANS.—Approv. Aug. 24, 1898, **98**, 537.

ALLEGHENY R., Pittsburgh to Allegheny, Pa. (S.) (Pittsburgh, Fort Wayne & Chicago Ry. Co.) PLANS.—Reconstr. approv. Sept. 1, 1900, **01**, 662.

ALLEGHENY R., Brilliant Station, Pittsburgh, Pa. (S.) (Pennsylvania R. R. Co.) PLANS.—Approv. Mar. 11, 1903, **03**, 649.

ALLEGHENY R., between Pittsburgh and Allegheny, Pa. (O.) (Union Br. Co., Union Br.) PLANS.—Alterations to be completed within 18 months from Jan. 26, 1903, **03**, 651.

ALLEGHENY R. (N. side Pt. Br.), near site of Old Union Br., Pittsburgh, Pa. (S.) (City br.) PLANS.—Approv. Sept. 8, 1909, **10**, 1024.

ALLEGHENY R., below Tarentum, Pa. (S.) (Kensington Rapid Transit Br. Co.) PLANS.—Submitted Mar. 28, 1894; modified Apr. 14, 1894; approv. Apr. 28, 1894, **94**, 428.

ALLEGHENY R., at Tuttletown, Pa. (S.) (Pennsylvania R. R. Co.) PLANS.—Reconstr. of br. No. 111, on the Salamanca Branch, approv. June 23, 1910, **10**, 1030.

ALLEGHENY R., Venango County, near mouth of E. Sandy R., Pa. (S.) (Franklin & Clearfield R. R. Co.) PLANS.—Approv. Oct. 18, 1905, **06**, 802.

ALLEY CREEK, at Bayside Douglaston, Borough of Queens, New York City. (S.) (New York & North Shore Traction Co.) PLANS.—Approv. Oct. 6, 1910, **11**, 1083.

ALLIGATOR R., N. C. (See Mill Tail Creek.)

ALLOWAY CREEK, Salem County, N. J. (S.) (Salem County br.) PLANS.—Rebuilding approv. Oct. 19, 1905, **06**, 803.

ALTAMAHA (Middle) **R.**, Ga. (See Altamaha R.)

ALTAMAHA (South) **R.**, Ga. (See Altamaha R.)

ALTAMAHA R. (Delta), Ga. (S.) (Georgia Coast & Piedmont R. R. Co.) PLANS.—Approv. Aug. 9, 1910, **11,** 1062.

ALTAMAHA R., Ga. (S.) (Georgia & Florida Ry.) PLANS.—Approv. June 28, 1907, **07,** 828.

ALTAMAHA R., Doctortown, Ga. (A.) (See Ashley R.; Ogeechee R.) (Savannah, Florida & Western R. R. Co.) PLANS.—Without a draw; an obstr., **88,** 2549, 2550.

ALTAMAHA R., at Doctortown, Ga. (S.) (Atlantic Coast Line R. R. Co.) PLANS.—Reconstr. approv. June 7, 1911, **11,** 1090.

ALTAMAHA R., Vidalia and Hazlehurst, Ga. (S.) (Georgia & Florida Ry.) PLANS.—approv. June 28, 1907, and modified plans approv. June 22, 1908, **08,** 873.

AMOS CREEK, N. J. (See Leonards Thoroughfare.)

ANACOSTIA R. (E. Branch of Potomac R.) (Benning's Br., upper.) ENGINEERS.—Maj. N. Michler, 1867–70. **R., 67,** 521; **68,** 890; **69,** 493; **70,** 518; **71,** 974. Maj. O. E. Babcock, 1871–77. **R., 71,** 969; **72,** 1015; (Col.) **74,** ii, 394; **75,** ii, 810; **76,** ii, 690; **77,** ii, 1066. Lt. Col. T. L. Casey, 1879–80. **R., 79,** 1882; **80,** 2342. Col. A. F. Rockwell, 1881–84. **R., 81,** 2715; **82,** 2738; **83,** 2101; **84,** 2346. Lt. Col. J. M. Wilson, 1885–86. **R., 85,** 2509; **86,** 2084. Lt. Col. C. J. Allen, 1899. **R., 99,** 1447. OPERATIONS.—**1867.** Recently rebuilt, **67,** 521. **1868–72.** Minor repairs made, **68,** 890; **70,** 518; **71,** 969, 974; **72,** 1015. **1874–77.** Repairs made, **74,** ii, 394; **76,** ii, 690; **77,** ii, 1066. **1878–79.** Thoroughly repaired, **79,** 1882. **1880–82.** Extensive repairs made, **80,** 2342; **81,** 2715; **82,** 2738. **1883–86.** Roadway repaired, **83,** 2101; **84** 2346; **85,** 2509; **86,** 2084. PROJECTS.—Br. forms an important connection between D. C. and Md., **70,** 518. Lt. Col. Wilson est., 1886, $10,000 to imp. the br., **86,** 2084.

ANACOSTIA R. (E. Branch of Potomac R.). (New Navy Yard Br.) APPROPRIATIONS.—**1874.** $146,000, **75,** ii, 806. CONTRACTS.—**1874.** Clark, Reeves & Co., br. (within limit of app., $146,000), **75,** ii, 806. ENGINEERS.—Chief of Engineers. **R., 75,** 126; **76,** ii, 688. In charge: Col. O. E. Babcock, 1875–77. **R., 75,** ii, 806; **76,** ii, 687; **77,** ii, 1066, 1070. Lt. Col. T. L. Casey, 1879–80. **R., 79,** 1882; **80,** 2342. Col. A. F. Rockwell, 1881–84. **R., 81,** 2715; **82,** 2738; **83,** 2101; **84,** 2346. Col. J. M. Wilson, 1885–86. **R., 85,** 2509; **86,** 2084. Lt. Col. C. J. Allen, 1899. **R., 99,** 1447. LEGISLATION.—Constr. au. act June 22, 1874; **75,** ii, 806. One of the R. R. tracks removed according to act Mar. 3, 1879; **79,** 1882. OPERATIONS.—**1874–75.** Br. completed and opened to the public June 17, 1875, **75,** ii, 806. **1876–77.** Some repairs made, **77,** ii, 1066. **1879–80.** Roadway and footwalks repaired, **80,** 2342. **1880–81.** Extensive repairs made, **81,** 2715. **1881–82.** Sidewalks, roadway, and brick pavements repaired, **82,** 2738. **1882–86.** Roadway repaired, **83,** 2101; **84,** 2346; **85,** 2509; **86,** 2084. PRIVATE (CORPORATE) WORK.—Permission to lay rails across the Anacostia Br. granted Mar. 14, 1876, to the Anacostia & Potomac R. R. R. Co., by the Sec. of War, under certain restrictions and regulations, **76,** ii, 688. Company removed a track, **79,** 1882. PROJECTS.—Lt. Col. Wilson est., 1886, $5,500 to imp. the br., **86,** 2084. SURVEYS.—Made, 1875, **75,** ii, 806. **R.,** 1875, by Col. Babcock, on the application of the Anacostia & Potomac R. R. R. Co. for permission to lay rails across the Anacostia Br. (see Private work), **76,** ii, 687.

ANACOSTIA R. (E. Branch of Potomac R.). (Old Navy Yard Br., lower.) ENGINEERS.—In charge: Maj. N. Michler, 1867–71. **R., 67,** 521; **68,** 891; **69,** 494; **70,** 518; **71,** 975. Maj. O. E. Babcock, 1870–74. **R., 71,** 969; **72,** 1015; (Col.) **74,** ii, 394. LEGISLATION.—Application, 1868, to Congress to incorporate the Uniontown & Washington City R. R. with au. to lay tracks along certain streets and to cross this br., **68,** 891. OPERATIONS.—**1867.** Br. recently renovated, **67,** 521. **1867–68.** Floor repaired, **68,** 891. **1869–70.** Continual repairs being made, **70,** 518; **71,** 975. **1873–74.** Broken span repaired, **74,** ii, 394. **1874–76.** Repairs made, **76,** ii, 690. PROJECTS.—Act au. br. to be sold by auction, June 21, 1875. Bids too low; no sale. **75,** ii, 810. SURVEYS.—Sur. of the lower br., known as the Navy Yard Br., across the Anacostia R., and plan for a permanent str. across same, capable of sustaining R. R. track and cars, with est. of cost, ordered by a resolution of the Senate, June 20, 1868; made, 1868, by Maj. Michler, **68,** 891; **69,** 494.

ANACOSTIA R. (E. Branch of Potomac R.). (Washington, D. C.) ENGINEERS.—Chief of Engineers. **R., 96,** 430. In charge: Maj. C. E. L. B. Davis, 1896. **R., 96,** 3889. PHYSICAL DATA.—Borings for site, **96,** 3892, 3901. Comparison of routes, **96,** 3895. PROJECTS.—Description of proposed br., **96,** 3895. Maj. Davis est., 1896, $779,130 to constr. br. at the foot of 1st Street SW., **96,** 3899. SURVEYS.—Sur., plan, and est. of constr. of a substantial and suitable br., with necessary approaches, from foot of South Capitol Street, or below it at the most available pt., across the E. Branch of the Potomac R., and **R.** thereon, au. act Mar. 2, 1895; made, 1896, by Maj. Davis (**R.** unfav. to site) (see Projects), **96,** 3890.

ANACOSTIA R., D. C. (Baltimore & Potomac R. R.) PROJECTS.—Description of br., **99,** 1447.

ANACOSTIA R., D. C. (Pennsylvania Avenue br.—highway.) PROJECTS.—Description of br., **99,** 1447.

ANACOSTIA R. (in line with Massachusetts Avenue extended). (Washington, D. C.) ENGINEERS.—Chief of Engineers. **R., 98,** 541. In charge: Lt. Col. C. J. Allen, 1898. **R., 98,** 3598. PHYSICAL DATA.—Borings, **98,** 3600. PROJECTS.—Col. Allen est., 1897, $441,208 for a steel truss br., **98**, 3606. Description of proposed br., **98**, 3602-3606. SURVEYS.—Sur., plan, and est. of br. across the E. Branch of the Potomac R. (Anacostia R.) in line with Massachusetts Avenue extended eastward, au. act Feb. 17, 1897; made, 1897, by Col. Allen (see Projects), **98**, 3599.

ANACOSTIA R., Washington, D. C. (S.) (Pennsylvania R. R. Co.) PLANS.—Approv. Sept. 22, 1903, **04**, 714.

ANACOSTIA R., Washington, D. C. (A.) (District of Columbia br.) PLANS.—Provision for reconstr. existing br. made by D. C. app. act Apr. 27, 1904, as amended by act Mar. 3, 1905. Plans approv. Apr. 7, 1905, **05**, 729.

ANAHEIM INLET and navigable chans. in Alamitos B., Cal. (S.) (Brs. (3) of Pacific Electric Ry. Co.) PLANS.—Approv. Apr. 22, 1904, **04**, 718.

ANNAVILLE CREEK, N. Y. (Dr.) **08**, 865.

ANNEMESSEX R., Md. (Dr.) **08**, 865.

APALACHICOLA R., Fla. (Sp.) (Apalachicola Northern R. R. Co.) Au. act Mar. 3, 1905. PLANS.—Approv. Dec. 13, 1905, and modified plans Feb. 24, 1906, **06**, 799.

APPONAGANSETT R., S. Dartmouth, Bristol County, Mass. (S.) (City br.) PLANS.—Approv. Oct. 30, 1901, **02**, 585.

APPOQUINIMINK R., New Castle County, Del. (S.) (New Castle County br.) PLANS.—Approv. Aug. 30, 1905, **06**, 801.

AQUIA CREEK, Va. (Dr.) **07**, 815.

AQUIA CREEK, Va. (S.) (Richmond, Fredericksburg & Potomac R. R. Co.) PLANS.—Plans for new draw in br. approv. June 6, 1895, **95**, 479.

AQUIA CREEK. (See Neabsco Creek.)

ARKANSAS R. (Dr.) (See Ouachita R. and Petit Jean R.) **05**, 719.

ARKANSAS R. and tributaries. (Dr.) **07**, 815.

ARKANSAS R., between Arkansas and Desha Counties, Ark. (Sp.) (Memphis, Helena & Louisiana Ry. Co.) Au. act Feb. 24, 1902. PLANS.—Approv. Aug. 14, 1902, **03**, 643.

ARKANSAS R., Cummings Landing, Ark. (Sp.) (Kansas City, Arkansas & New Orleans R. R. Co. at.) Au. act July 24, 1888, **90**, 337. PLANS.—Plan and location submitted and approv. by Sec. of War, Feb. 25, 1890, **90**, 337.

ARKANSAS R., Dardanelle, Ark. (Sp.) (Cable City Br. Constr. Co.) LEGISLATION.—Company au. to constr. br. by act Sept. 30, 1890, **91**, 430. Au. to erect an addl. tower to operate draw, conditionally, May 16, 1891, **91**, 430. PLANS.—Approv. Dec. 23, 1890, **91**, 430.

ARKANSAS R., near Fort Gibson, Ind. T. (Sp.) (Ozark & Cherokee Central Ry. Co.) Au. act Feb. 24, 1902. PLANS.—Approv. July 17, 1902, **03**, 642.

ARKANSAS R., Fort Smith, Ark. (Sp.) (Kansas & Arkansas Valley R. R. Co.) LEGISLATION.—Au. act Mar. 15, 1890. PLANS.—Plan and location submitted and approv. by Sec. of War, May 17, 1890, **90**, 338.

ARKANSAS R., at Fort Smith and Van Buren, Ark. (Sp.) (Fort Smith & Van Buren br. district.) Au. Feb. 26, 1910. PLANS.—Approv. May 5, 1910, **10**, 1022.

ARKANSAS R., near Hicks Rock, Ind. T. (Sp.) (Kansas City, Pittsburg & Gulf R. R. Co. LEGISLATION.—Company au. to constr. br. by act Feb. 27, 1893. PLANS.—Plans submitted June 21, 1895; modified July 22, 1895; approv. July 29, 1895, **95**, 476.

ARKANSAS R., Little Rock, Ark. (Sp.) Chief of Engineers. R., **81**, 267; **84**, 270, 1789. LEGISLATION.—Br. au. acts July 1, 1870, and May 31, 1872, **81**, 2010; **84**, 270, 1789. PLANS.—Submitted by Little Rock Br. Co. in compliance with act May 31, 1872; approv. by Chief of Engineers and Sec. of War, Feb. 15, 1873, **73**, 591, 592. Requirements of Congress, **81**, 2010. Plan, br. company, **81**, 2013. Board of surveyors convened at Little Rock. Br. unequal to the requirements of commerce, **81**, 2013. Modifications recom. by Maj. Adams, concurred in by Chief of Engineers, and approv. by Sec. of War, **84**, 1790, 1791.

ARKANSAS R., Little Rock, Ark. (Sp.) (Choctaw & Memphis R. R. Co.) LEGISLATION.—Company au. to constr. br. by act Jan. 10, 1899. PLANS.—Approv. Mar. 1, 1899, **99**, 618.

ARKANSAS R., Little Rock, Ark. (Sp.) (Little Rock Br. & Terminal Ry. Co.) LEGISLATION.—Company au. to constr. br. by act Mar. 2, 1891; amendment by act Feb. 11, 1893. PLANS.—Approv. Dec. 7, 1893, **94**, 425.

ARKANSAS R., Little Rock, Ark. (Sp.) (Pulaski County br.) LEGISLATION.—County au. to constr. br. by act Feb. 28, 1893; amending act, May 13, 1896. PLANS.—Approv. June 12, 1896, **96**, 423.

ARKANSAS R., at or near Muskogee, Okla. (Sp.) (Muskogee & Fort Gibson Br. Co.) Au. act Aug. 16, 1911. PLANS.—Plans and map of location approv. May 31, 1912, **12**, 1298.

ARKANSAS R., Pine Bluff, Ark. (Sp.) (Jefferson County br.) Au. act Mar. 5, 1906. PLANS.—Approv. Aug. 31, 1906, **07**, 817.

ARKANSAS R., below Pine Bluff (Rob Roy), Ark. (Sp.) (St. Louis & Southwestern Ry Co.) Au. act June 27, 1882. PLANS.—Plans for br. to replace existing str. approv. Aug. 3, 1909, **10**, 1020.

ARKANSAS R., Van Buren, Ark. (Sp.) **84**, 270, 1792. LEGISLATION.—Br. au. by act July 3, 1882, **84**, 270. PLANS.—Plans as orig. proposed modified by recom. of a BE. R. R. company objected to the changes. In 1884 the R. R. proposed to constr. at its own expense any work which might subsequently be found necessary for the mainten. of navigation. Chief of Engineers thereupon recom. approval of orig. site, which was approv. by Sec. of War. **84**, 270, 1792, 1796.

ARKANSAS R., near Van Buren, Ark. (Sp.) (Fort Smith & Van Buren Ry. Co.) LEGISLATION.—Company au. to constr. br. by act Mar. 9, 1894. PLANS.—Approv. Mar. 8, 1895, **95,** 475.

ARTHUR KILL, N. J., and tributaries. (Dr.) **06,** 797.

ASHEPOO R., S. C. (A.) (Charleston & Savannah R. R. br.—new.) Engineer in charge: Capt. F. V. Abbot, 1899. **R.** PLANS.—Company should be required to remove piles of old br. if the U. S. ever does any work on this R., **89,** 2796.

ASHLEY R., S. C. (O.) (New br. company.) PLANS.—Required alterations to be, and were completed by July 1, 1891, **91,** 433.

ASHLEY R., S. C. (S.) (Charleston, S. C., Mining & Manufacturing Co.) PLANS.—Approv. Mar. 7, 1902, **02,** 587.

ASHLEY R., Bees Ferry, S. C. (O.) (Atlantic Coast Line R. R. Co.) PLANS.—Alterations to be completed on or before 6 months from Apr. 12, 1909, **09,** 920.

ASHLEY R., Charleston, S. C. (O.) (Charleston Br. Co.) PLANS.—Alterations to be completed on or before 8 months from Feb. 5, 1909, **09,** 919.

ASHLEY, EDISTO, SALKAHATCHIE, CHEEHAN, SAVANNAH, and **ALTAMAHA RS.,** and **ST. AUGUSTINE CREEK,** Ga. and S. C. (A.) PLANS.—Description of the brs. and of the modifications proposed therein, **88,** 2629, 2630. Modifications suggested by Col. Gillmore in such of these structures as obstr. navigation **88,** 2663.

ASHTABULA R., Ohio. (O.) (Ashtabula County br.) PLANS.—Specified alterations required on or before Apr. 1, 1898, **96,** 429. Alterations to be completed on or before Apr. 15, 1905, **04,** 723.

ASHTABULA R., Ashtabula, Ohio. (S.) (Lake Shore & Michigan Southern Ry. Co.) PLANS.—Reconstr. plans approv. May 11, 1897, **97,** 534. Reconstr. approv. Mar. 14, 1911, **11,** 1067.

ASSISCUNK CREEK, at Mitchell Avenue, Burlington, N. J. (S.) (Burlington County br.) PLANS.—Approv. July 7, 1904, **05,** 722.

ASSISCUNK CREEK, N. J. (S.) (Brs. of the Pennsylvania R. R. Co.) PLANS.—Plans and maps of locations approv. Nov. 4, 1911, **12,** 1302.

ATCHAFALAYA R., near mouth of Malboeuf Bayou, La. (S.) (Morgan's Louisiana & Texas R. R. & S. S. Co.) PLANS.—Approv. Apr. 30, 1906, **06,** 806.

ATCHAFALAYA R., near Melville, La. (S.) (Colorado Southern, New Orleans & Pacific R. R. Co.) PLANS.—Approv. Aug. 15, 1906, **07,** 821. For altering, approv. June 30, 1909, **09,** 919.

ATCHAFALAYA R., Morgan City, La. (S.) (Morgan's Louisiana & Texas R. R. & S. S. Co.) PLANS.—Rebuilding approv. Aug. 26, 1907, **08,** 869.

ATKINS B., Kennebec R., Phippsburg, Me. (Sp., etc.) (Sagadahoc County br.) LEGISLATION.—County au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Maine, **92,** 405. PLANS.—Submitted July 30, 1891. On May 2, 1892, no objections, **92,** 405.

B.

BACK BAY, Biloxi, Miss. (Sp.) (City br.) Au. act May 10, 1900. PLANS.—Approv. Sept. 4, 1900, **01,** 659.

BACK COVE (chan. leading to), Portland H., Me. (q. v.). (O.) (Grand Trunk Ry. Co. of Canada.) PLANS.—Specified alterations required on or before Jan. 1, 1892, **91,** 435.

BACK R., Md. (S.) (The United Railways & Electric Co. of Balitmore, Md.) PLANS.—For rebuilding approv. Apr. 10, 1903, **03,** 649.

BACK R., Md. (S.) (Chesaco Park Br. Co.) PLANS.—Plans and map of location approv. Sept. 20, 1911, **12,** 1301.

BACK R., at Eastern Avenue, Baltimore, Md. (S.) (County br.) PLANS.—Approv. Jan. 9, 1911, **11,** 1085.

BACK R., between Tibbetts Isld. and the mainland in town of Boothbay, Me. (S.) (Br. of W. O. Whitman.) PLANS.—Approv. Apr. 7, 1911, **11,** 1088.

BACK R., Md. (See North East Creek.)

BACK (Butler) **R.,** Ga. (See Atlamaha R.)

BAHIA HONDA. (See Florida Keys.)

BAINES CREEK, near Port Norfolk, Va. (S.) (Atlantic Coast Line R. R. Co.) PLANS.—Plans and map of location for reconstr. of existing br. approv. Jan. 13, 1912, **12,** 1304.

BALL CLUB R., Minn. (S.) (Eastern Ry. Co.) PLANS.—Approv. Apr. 7, 1898, **98,** 535.

BALL CLUB R., Itaska County, Minn. (S.) (Great Northern Ry. Co.) PLANS.—For br. to replace existing str. approv. Sept. 10, 1907, **08,** 870.

BAR H. and **BAR ISLD.** (chan. between), Me. (S.) (Eden Township br.) PLANS.—Approv. Apr. 21, 1909, **09,** 917.

BARLOWS R., Bourne, Mass. (S.) (Town br.) PLANS.—Reconstr. plans approv. May 24, 1898, **98,** 535.

BARNEGAT B., at Seaside Park, N. J. (S.) (Philadelphia & Long Branch R. R. Co.) PLANS.—For reconstr. of existing br. approv. Nov. 13, 1911, **12,** 1302.

BARRINGTON R., at Barrington, R. I. (S.) (New York, New Haven & Hartford R. R. Co.) PLANS.—For reconstr. of existing br. (including erection of temporary trestle br.) approv. Sept. 7, 1911, **12,** 1301.

BARROWS CANAL, La. (Dr.) **08,** 865.

BARTHOLOMEW BAYOU, Portland, Ark. (Sp.) (Mississippi R., Hamburg & Western Ry. Co.) LEGISLATION.—Company au. to constr. br. by act Mar. 12, 1898, **98,** 531. Act extending au. Feb. 4, 1902, **02,** 582. PLANS.—Approv. May 17, 1898, **98,** 531. Br. built, but not in accordance with permit. Rebuilding approv. Mar. 15, 1902, **02,** 582.

BARTHOLOMEW BAYOU, Parkdale, Ark. (Sp.) (Ashley County br.) Au. act Apr. 1, 1908. PLANS.—Approv. Oct. 25, 1910, **10,** 1020.

BARTHOLOMEW BAYOU, near Portland, Ark. (Sp.) (Ashley County br.) Au. act Feb. 20, 1908, and Jan. 27, 1910. PLANS.—Approv. Oct. 6, 1910, **11,** 1080.

BARTHOLOMEW BAYOU, La. (Sp.) (New Orleans & Northwestern Ry. Co.) Au. act May 4, 1900. PLANS.—Approv. Apr. 30, 1901, **01,** 660.

BARTHOLOMEW BAYOU, La. (Sp.) (Arkansas, Louisiana & Gulf Ry. Co.) Au. act Mar. 23, 1906, and Feb. 22, 1907. PLANS.—Approv. Sept. 20, 1907, **08,** 866.

BASS R., Beverly, Mass. (S.) (Essex County br.) PLANS.—Reconstr. approv. Oct. 6, 1904, **05,** 724.

BASS R., Yarmouth and Dennis, Mass. (S.) (Barnstable County br.) PLANS.—Reconstr. approv. May 15, 1907, **07,** 827.

BASTROP BAYOU and **CHOCOLATE BAYOU,** Tex. (Sp., etc.) (Brazoria County brs.) LEGISLATION.—County au. to constr. brs. under act July 13, 1892, sec. 3, and act Texas. PLANS.—For these 2 brs. approv. Aug. 24, 1892, **92,** 409.

BAUDETTE R., Beltrami County, Minn. (S.) (County br.) PLANS.—Approv. Apr. 21, 1906, **06,** 806.

BAY R., at Bayboro, N. C. (O.) (Pamlico County br.) PLANS.—Alterations to be completed on or before Nov. 1, 1902, **03,** 652.

BAY R., near Bayboro, N. C. (S.) (Virginia & Carolina Coast R. R. Co.) PLANS.—Approv. Nov. 3, 1906, **07,** 823.

BAY ST. LOUIS, Miss. (Dr.) **08,** 865.

BAYOU BOEUF, La. (Dr.) **08,** 865.

BAYOU CONNER, La. (Dr.) **08,** 865.

BAYOU COURTABLEAU, La. (Dr.) **08,** 865.

BAYOU DES ALLEMANDS, La. (Dr.) **08,** 865.

BAYOU LACASINE, La. (Dr.) **08,** 865.

BAYOU LAFOURCHE, La. (Dr.) **08,** 865.

BAYOU SARA, La. (Dr.) **08,** 865.

BAYOU VERMILION, La. (Dr.) **08,** 865.

BEACH THOROUGHFARE. (See Schuylkill R., etc.)

BEACH THOROUGHFARE, Atlantic City, N. J. (S.) (Pleasantville & Atlantic Turnpike or Plank Road Co.) PLANS.—Approv. Jan. 5, 1903, **03,** 647.

BEACH THOROUGHFARE, near Atlantic City, N. J. (S.) (Atlantic City & Shore R. R. Co.) PLANS.—Approv. Jan. 25, 1906, **06,** 803.

BEACH THOROUGHFARE, at Riviera Beaches and Atlantic City, N. J. (S.) (Atlantic City Riviera Parkway Co.) PLANS.—Approv. June 8, 1910, **10,** 1030.

BEAR CREEK, near Sparrows Pt., Md. (S.) (Dundalk, Sparrows Pt. & North Pt. Ry. Co.) PLANS.—Approv. Apr. 14, 1902, **02,** 588.

BEAR CREEK, between Sunflower and Washington Counties, Miss. (S.) (Delta Southern Ry. Co.) PLANS.—Approv. Sept. 27, 1906, **07,** 822.

BEAR CREEK, at Swift, Miss. (S.) (Leflore County br.) PLANS.—Approv. Jan. 26, 1911, **11,** 1086.

BELFAST B., Me. (S.) (City br.) PLANS.—Approv. Dec. 6, 1895, **96,** 425.

BELLE R., St. Clair County, Mich. (S.) (Detroit, Mount Clemens & Marine City Ry. Co.) PLANS.—Approv. May 9, 1901, **01,** 666.

BELLE R., Marine City, Mich. (S.) (Rapid Ry. Co.) PLANS.—Approv. July 3, 1899, **99,** 623.

BELLE R., Marine City, Mich. (S.) (Detroit & Northern Ry. Co.) PLANS.—Approv. July 26, 1899, **99,** 623.

BELLMANS CREEK, Granton, N. J. (S.) (New York Central & Hudson R. R. R. Co.) PLANS.—Reconstr. approv. Sept. 6, 1904, **05,** 724.

BELVEDERE and **TIBURON** (tidal estuary between), Morin County, Cal. (O.) (County br.) PLANS.—Alterations to be completed on or before May 1, 1910, **10,** 1031.

BENNETTS CREEK, Va. (S.) (Seaboard Traction Co.) PLANS.—Approv. June 23, 1905, **05,** 728.

BERNARD BAYOU, Handsboro, Miss. (S.) (Handsboro Township br.) PLANS.—Approv. July 30. 1908, **09,** 914.

BERRY CREEK, Paterson Plank Road, Bergen County, N. J. (S.) (Bergen County br.) PLANS.—Approv. May 22, 1909, **09,** 918.

BERRYS CREEK, N. J. (Dr.) **10,** 1019.

BERWICK B., La. (Dr.) **08,** 865.

BEVERLY H., between Salem and Beverly, Mass. (S.) (Essex County br.—Essex br.) PLANS.—Reconstr. plans for the draw and plans for a temporary br. approv. Nov. 19, 1896, **97,** 532.

BIG BLACK R., Miss. (A.) Engineer in charge, Capt. E. Bergland. PLANS.—Description of Louisville, New Orleans & Texas R. R. br. An obstr. at all stages of water. Center span should be made a pivot draw. The 2 county brs. should be changed to drawbrs. Description of Vicksburg & Meridian R. R. br. Au. by Mississippi, 1865. An obstr. at all stages. 1 of the ps. should be replaced by a pivot pr. and 2 of the spans by a pivot draw. **88,** 2554.

BIG BLACK R., Baldwin Ferry (about 15 m. e. of Vicksburg, Miss.). (Sp., etc.) Warren County br.) LEGISLATION.—County au. to constr. br. under act Sept. 19, 1890, sec. 7, and act Mississippi. PLANS.—Approv. Apr. 28, 1892, **92,** 405.

BIG BLACK R., Hankinsons Ferry, Miss. (S.) (Warren County br.) PLANS.—Approv. Aug. 30, 1894, **94,** 430. Rebuilding approv. Aug. 22, 1908, **09,** 915.

BIG BLACK R., Ivanhoe Ferry, Miss. (S.) (Warren County br.) PLANS.—Approv. Sept. 25, 1907, **08,** 870. Modified plans approv. Aug. 10, 1908, **09,** 914.

BIG FORK R., Itaska County, Minn. (S.) (Minneapolis & Rainy R. Ry. Co.) PLANS.—Approv. July 19, 1906, **07,** 820.

BIG FORK AND LITTLE SHOALS RS., Minn. (S.) (Brs. of International Br. & Terminal Co.) PLANS.—Approv. Aug. 16, 1910, **11,** 1083.

BIG HATCHEE R., near Brownsville, Tenn. (S.) (Haywood County br.) PLANS.—Approv. July 16, 1898, **98,** 536.

BIG HORN R., Mont. (across the). (A.) (Br. of the Northern Pacific R. R. Co.) PLANS.—An obstr.; should be provided with a draw giving a free chan. way of 100′ width, **88,** 2670.

BIG MUDDY R., at Murphysboro, Ill. (S.) (Murphysboro & Southern Illinois Ry. Co.) PLANS.—Approv. Feb. 8, 1910, **10,** 1027.

BIG MUDDY R., at 35 m. above its mouth near Murphysboro, Ill. (S.) PLANS.—Reconstr. of existing br. approv. Aug. 17, 1911, **12,** 1300.

BIG SANDY R. (See Ohio R., etc.)

BIG SANDY R., W. Va. (near the mouth of the). (A.) (Chesapeake & Ohio R. R. Co.) PLANS.—Capt. Post recom. removal of pile and cofferdam obstrs. about one of the ps., **88,** 2578.

BIG SANDY R., at Catlettsburg, Ky. (Sp.) (Chesapeake & Ohio R. R. Co.) LEGISLATION.—Constr. au. act Feb. 15, 1893, **93,** 464. PLANS.—To replace existing str., approv. Feb. 25, 1893, **93,** 464. Modified plans, omitting the roadway and sidewalks, Nov. 23, 1894, approv. Nov. 30, 1894, **95,** 474.

BIG SANDY R., near Dolorme (Tug Fork), W. Va. (Sp.) (Frank P. Harman.) Au. act Apr. 18, 1904. PLANS.—Approv. Oct. 8, 1904, **05,** 720.

BIG SANDY R., from Kenova, W. Va., to Catlettsburg, Ky. (Sp.) (Ohio Valley Electric Ry. Co.) LEGISLATION.—Company au. to constr. br. by act Apr. 30, 1900, **00,** 697. PLANS.—Approv. June 12, 1900, **00,** 697.

BIG SANDY R., Levisa Fork, Ky. (S.) Millers Creek R. R. Co.) PLANS.—Approv. June 25, 1909, **09**, 919. Modified plans approv. July 31 1909, **10**, 1023.

BIG SANDY R. (Levisa Fork), near Auxier, Ky. (S.) (North-East Coal Co.) PLANS.—Approv. Apr. 20, 1910, **10**, 1029.

BIG SANDY R., Levisa Fork, Pikeville, Ky. (S.) (Pike County br.) PLANS.—Approv. May 27, 1908, **08**, 872.

BIG SANDY R. (Levisa Fork), Prestonburg, Ky. (S.) (William H. May et al.) PLANS.—Approv. Mar. 18, 1907, **07**, 826.

BIG SANDY R. (Levisa Fork), Torchlight, Ky. (S.) (Louisa Coal Co.) PLANS.—Approv. June 25, 1909, **09**, 918.

BIG SANDY R. (Levisa Fork), near Whitehouse, Ky. (S.) (Big Sandy Ry. Co., Chesapeake & Ohio Ry. Co.) PLANS.—Approv. Oct. 28, 1902, **03**, 647.

BIG SANDY R. (Russell Fork), at Elkhorn City, Ky. (S.) (Pike County br.) PLANS.—Approv. Feb. 27, 1912, **12**, 1305.

BIG SANDY R., Tug and Levisa Forks, Louisa, Ky., and Cassville, W. Va. (Sp.) (Louisa & Fort Gay Br. Co.) Au. act Mar. 3, 1905. PLANS.—Approv. May 12, 1905, **05**, 722.

BIG SANDY R., Tug Fork (91 and 95¼ m. above Catlettsburg, Ky.—2 brs.). (Norfolk & Western R. R. Co.) LEGISLATION.—Company au. to constr. brs. by act Feb. 9, 1891. PLANS.—Plans for the 2 brs. approv. Feb. 13, 1891, **91**, 431.

BIG SANDY R., Tug Fork, near Devon, W. Va. (Sp.) (Majestic Collieries Co.) Au. act Feb. 8, 1907. PLANS.—Approv. Feb. 6, 1908, **08**, 867.

BIG SANDY R., Tug Fork, near Matewan, W. Va. (Sp.) (Blackberry, Kentucky & West Virginia Coal & Coke Co., Inc.) Au. act Apr. 21, 1904. PLANS.—Approv. June 22, 1904, **04**, 712.

BIG SANDY R., Tug Fork, in Mingo County, W. Va., and Buchanan County, Va. (Sp.) (Brs. of Norfolk & Western Ry. Co.) Au. act Apr. 12, 1904. PLANS.—Approv. June 6. 1905, **05**, 722.

BIG SANDY R., Tug Fork, between Mingo County, W. Va., and Pike County, Ky. (Sp.) (Norfolk & Western Ry. Co.) Au. act Apr. 12, 1904. PLANS.—Approv. June 24, 1904, **04**, 712.

BIG SANDY R., Tug Fork, at Nolan, W. Va. (Sp.) (Borderland Coal Co.) Au. act Mar. 3. 1905. PLANS.—Approv. Apr. 27, 1905 **05**, 721.

BIG SANDY R., Tug Fork (2 m. e. of Nolan, W. Va.). (Sp.) (Borderland Coal Co.) Au. act Feb. 19, 1910. PLANS.—Approv. May 12, 1910, **10**, 1022.

BIG SANDY R., Tug Fork, near Sprigg, W. Va. (Sp.) (Burnwell Coal & Coke Co.) Au. act Mar. 2, 1907. PLANS.—Approv. July 23, 1907 **08**, 866.

BIG SANDY R., Tug Fork, Vulcan, W. Va. (Sp.) (Vulcan Coal Co.) Au. act Apr. 12, 1904. PLANS.—Approv. Apr. 25, 1904, **04**, 712.

BIG SANDY R., Tug Fork, Williamson, W. Va. (Sp.) (Kentucky & West Virginia Br. Co.) Au. act Feb. 27, 1907. PLANS.—Approv. May 21, 1907, **07**, 819.

BIG SUNFLOWER R., Boyers Mill, near Vicks Landing, Miss. (Sp.) (Sunflower County br.) Au. act Jan. 24, 1905. PLANS.—Approv. May 29, 1906, **06**, 800.

BIG SUNFLOWER R., Sharkey County, Miss. (Sp.) (Delta Southern Ry.) Au. act Jan. 28, 1905. PLANS.—Approv. Feb. 12, 1906, Jan. 27, 1906, and Oct. 25, 1906, **06**, 799; **07**, 817.

BIG SUNFLOWER R. (See Little Sunflower R.)

BIG TIMBER CREEK, below Gloucester, N. J. (S.) (Camden, Gloucester & Woodbury Ry. Co.) PLANS.—Reconstr. approv. Mar. 30, 1901, **01**, 666.

BIG TIMBER CREEK, Westville, N. J. (S.) (Pennsylvania R. R. Co.) PLANS.—Reconstr. approv. Mar. 2, 1906, **06**, 804.

BILOXI, Miss. (Dr.) **04**, 710.

BILOXI B., Miss. (Dr.) **08**, 865.

BILOXI R., at Lorraine, Miss. (S.) (Harrison County br.) PLANS.—Approv. June 28, 1912, **12**, 1308.

BIRCH R., W. Va. (See Elk R.)

BISCAYNE B., at Miami, Fla. (S.) (John S. Collins.) PLANS.—Approv. May 17 1912, **12**, 1307.

BLACK CREEK, Fla. (S.) (Walton County br.) PLANS.—Approv. July 9, 1898, **98**, 536.

BLACK CREEK, Clay County, Fla. (S.) (Jacksonville, Tampa & Key West Ry. Co.) PLANS.—Reconstr. approv. Aug. 15, 1893, **93**, 470.

BLACK CREEK, 6 m. e. of Freeport, Fla. (S.) (Walton County br.) PLANS.—Approv. Feb. 14, 1912, **12**, 1305.

BLACK R. (See Monongahela R. and.)

BLACK R., Ark. (Dr.) **07**, 815.

BLACK R., near Beattys Br., N. C. (S.) (Blanden County br.) PLANS.—Approv. Dec. 26, 1900, **01**, 664.

BLACK R., Earlington, Wash. (S.) (Jones-Thompson Investment Co.) PLANS.—Approv. Aug. 2, 1907, **08**, 868.

BLACK R., Fishers Ferry, Miss. (S.) (Warren County br.) PLANS.—Approv. Oct. 10, 1901 **02**, 585.

BLACK R., near Jonesville, in Catahoula Parish, La. (S.) (Louisiana & Arkansas Ry. Co.) PLANS.—Approv. Oct. 3, 1911, **12**, 1301.

BLACK R., King County, Wash. (S.) (Seattle & Renton Ry. Co.) PLANS.—For br. to replace existing str. approv. Aug. 5, 1902, **03**, 645.

BLACK R., King County, Wash. (S.) (Columbia & Puget Sound R. R. Co.) PLANS.—For br. to replace str. approv. June 5 1908 **08**, 873.

BLACK R., Lorain, Ohio. (S.) (Lorain County br.) PLANS.—Approv. Oct. 19 1898, **99**, 621.

BLACK R., Lorain. Ohio. (S.) (New York, Chicago & St. Louis R. R. Co.) PLANS.—For br. to replace existing str. approv. July 17, 1902, **03**, 645.

BLACK R., near Paroquet, Ark. (Sp.) (St. Louis, Iron Mountain & Southern Ry. Co.) Au. act Feb. 19, 1910. PLANS.—For reconstr. approv. Mar. 16, 1910, **10**, 1021.

BLACK R., Pocahontas, Ark. (Sp.) (Pocahontas Br. Co.) LEGISLATION.—Company au. to constr. br. by act Apr. 21, 1898. PLANS.—Approv. Nov. 17, 1898, **99**, 618.

BLACK R., at Pocahontas, Ark. (Sp.) (St. Louis & San Francisco R. R. Co.) Au. act Aug. 5, 1909. PLANS.—Approv. Aug. 19, 1910, **11**, 1079.

BLACK R., 10th Street, Port Huron, Mich. (S.) (City br.) PLANS.—Approv. June 29, 1897, **97**, 534.

BLACK R., Elwood Street, Port Huron, Mich. (S.) (City br.) PLANS.—Modified plans approv. Oct. 26, 1897, **98**, 533.

BLACK R., connecting Huron Avenue and Military Street, Port Huron, Mich. (S.) (City br.) PLANS.—Approv. June 8, 1912, **12**, 1308.

BLACK R., near Renton, Wash. (S.) (State br.) PLANS.—Approv. Oct. 15, 1910, **11**, 1084.

BLACK R., South Haven, Mich. (A.) PLANS.—Wooden br., narrow draw opening, partly obstr. navigation; an all-iron swinging br. to take its place under consideration, **89**, 800, 2801.

BLACK R., Still Bluff, N. C. (S.) (Pender County br.) PLANS.—Approv. July 5, 1900, **01**, 661. Modified plans approv. Feb. 6, 1903 **03**, 648.

BLACK R., Wash. (S.) (Seattle & Rainier Beach Ry. Co.) PLANS.—Approv. Sept. 11, 1896, **97**, 531.

BLACK ROCK H., Niagara R., and Erie Canal at Buffalo, N. Y. (O.) (International Br. Co. and Grand Trunk Ry. Co.) PLANS.—Alterations to be completed on or before Mar. 1, 1910, **08**, 873.

BLACK WARRIOR R., Demopolis, Ala. (S.) (Demopolis Improvement Co.) PLANS.—Approv. Apr. 4, 1906, **06**, 805.

BLACK WARRIOR R. (Locust Fork of), Ala. (S.) (North Alabama R. R. Co.) PLANS.—Approv. Jan. 13, 1906, **06**, 803.

BLACK WARRIOR R. (Locust Fork of), near Short Creek, Ala. (S.) (Ensley Southern Ry. Co.) PLANS.—Approv. Jan. 5, 1907, **07**, 824.

BLACK WARRIOR R. (Mulberry Fork of), at foot of Sanders Shoals, Ala. (S.) (Walker County br.) PLANS.—Approv. Dec. 30, 1911, **12**, 1303.

BLACK WATER CREEK, Dorchester County, Md.) (S.) (County br.) PLANS.—Approv. Dec. 20, 1910, **11**, 1085.

BLACKWATER R., Fla. (S.) (Louisville & Nashville R. R. Co.) PLANS.—For rebuilding approv. Dec. 9, 1909, **10**, 1026.

BLACKWATER R., Bagdad, Fla. (S.) (Stearns & Culver Lumber Co.) PLANS.—Approv. Sept. 2, 1904, **05**, 723.

BLACKWATER R., South Quay, Va. (S.) (Br. of Nansemond and Southampton Counties.) PLANS.—Approv. Nov. 14, 1906, **07**, 823.

BLIND R., in St. John the Baptist and Livingston Parishes, La. (S.) (Lyon Cypress Lumber Co.) PLANS.—Approv. Aug. 16, 1910, **11**, 1082.

BLIND R., between Ascension and Livingston Parishes, La. (S.) (Lyon Cypress Lumber Co.) PLANS.—Approv. Nov. 2, 1910, **11**, 1084.

BLIND SLOUGH, Oreg. (Dr.) **02**, 581.

BLIND SLOUGH, Oreg. (S.) (Astoria & Columbia R. R. R. Co.) PLANS.—Submitted May 22, 1896; approv. Mar. 8, 1897, **97**, 533.

BLOUNTS CREEK, Beaufort County, N. C. (S.) (Beaufort County br.) PLANS.—Approv. July 19, 1901, **02**, 583.

BLUE RUN (Wekiva R.). (See Withlacoochee R.)

BODINE CREEK, Port Richmond, Staten Isld., N. Y. (S.) (Baltimore & Ohio R. R. Co., Staten Isld. Rapid Transfer R. R.) PLANS.—Rebuilding approv. June 21, 1906, **06**, 808.

BOEUF BAYOU, at Avoca Plantation, La. (S.) (Avoca Drainage District Commission.) PLANS.—Approv. Apr. 1, 1912, **12**, 1306.

BOEUF BAYOU, St. Mary and Assumption Parishes, La. (S.) (Morgan's Louisiana & Texas R. R. & S. S. Co.) PLANS.—Recon. approv. Aug. 28, 1907, **08**, 869.

BOEUF BAYOU, Lafourche Parish, La. (S.) (Bowie Lumber Co.) PLANS.—Approv. Mar. 28, 1904, **04**, 717.

BOEUF R., Rayville, La. (Sp.) (New Orleans & Northwestern Ry. Co.) PLANS.—Reconstr. approv. Jan. 7, 1902, **02**, 582.

BOGUE CHITTO, Franklinton, Washington Parish, La. (S.) (Washington Parish br.) PLANS.—Br. to replace existing str. approv. Apr. 16, 1903, **03**, 650.

BOGUE PHALIA, near Elizabeth, Miss. (S.) (Yazoo & Mississippi Valley R. R. Co.) PLANS.—Reconstr. approv. May 20, 1908, **08**, 872.

BOOTHBAY, Me. (See Back R.)

BOOTHBAY H., Me. (S.) (Town br.) PLANS.—Approv. June 5, 1901 **01**, 666.

BOSTON H. and tributaries, Mass. (Dr.) **10**, 1019.

BOSTON H. (navigable waterway bet. Q Street and Castle Island), Mass. (Sp., etc.) (Board of Park Commissioners of Boston Mass.) LEGISLATION.—Commissioners au. to constr. br. under act Sept. 19 1890, sec. 7, and act of Massachusetts. PLANS.—Approv. Dec. 12, 1891, **92**, 402.

BOSTON H., Boston to E. Boston. (S.) COMMERCE.—Number of vessels that passed brs.

across Charles and Mystic Rs., 1867, 68, 821. C. interests involved, 68, 822. Discussion by Col. Foster of the injury to navigation thereby, 68, 821; by Gov. Bullock, 68, 826. Effect upon the interests of the U. S. navy yard at Charlestown, 68, 823, 826.—Chief of Engineers. R., 68, 69. Objections apparent, 68, 820. Senate Committee on C. asked views of Sec. of War on Senate bill 566. Views of Chief of Engineers, 68, 820. LEGISLATION.—Act of Massachusetts incorporating the Maverick Br. Co. 68, 824; passed over governor's veto, 68, 823; veto message, 68, 826. Act of Massachusetts au. purchase by U. S. of navy-yard site, 68, 827. PLANS.—By Maverick Br. Co., 68, 821. R. of Lt. Col. Foster on plan, 68, 821.

BOSTON H., Fort Pt. Chan., Mass. (O.) (Boston city br., Congress Street br.) PLANS.—Alterations to be completed before Dec. 31, 1903, 03, 652.

BOSTON H., Fort Pt. Chan., Mass. (O.) (Boston city br., Mount Washington Avenue br.) PLANS.—Alterations to be completed before Dec. 31, 1903, 03, 652.

BRANDON CREEK, Manatee County, Fla. (S.) (Manatee County br.) PLANS.—Approv. Oct. 11, 1906, 07, 822.

BRANDYWINE CREEK (4th Street extended, Wilmington, Del.). (Sp., etc.) (Cherry Isld. Marsh Co.) LEGISLATION.—Company au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Delaware. PLANS.—Approv. Oct. 26, 1891. Completion of br. reported on May 12, 1892. 92, 400.

BRANDYWINE CREEK, Wilmington, Del. (S.) (Brandywine Ry. Co.) PLANS.—Approv. Mar. 17, 1902, 02, 587.

BRANDYWINE CREEK, Wilmington, Del. (S.) (Philadelphia, Baltimore & Washington R. R. Co.) PLANS.—Rebuilding approv. Apr. 13, 1903, 03, 649, 650.

BRANDYWINE R. (connecting Moylan Avenue and 4th Street, Wilmington, Del.). (S.) (New Castle County br.) PLANS.—Reconstr. plans approv. Aug. 12, 1899, 99, 623.

BRANDYWINE R., Del. (Dr.) 02, 581.

BRAVE BOAT H., between Kittery and York, Me. (S.) (Portsmouth, Kittery & York Street Ry. Co.) PLANS.—Approv. June 18, 1897, 97, 534.

BRAYS BAYOU, Harrisburg, Tex. (S.) (Galveston, Harrisburg & San Antonia Ry. Co.) PLANS.—Approv. Jan. 13, 1903, 03, 647, 648.

BRAZOS R., Tex. (S.) (St. Louis, Brownsville & Mexico Ry. Co.) PLANS.—Approv. Oct. 6, 1905, 06, 902.

BRAZOS R., at Brazoria, Tex. (S.) (Brazoria County br.) PLANS.—Approv. July 20, 1911, 12, 1300.

BRAZOS R., Columbia, Tex. (S.) (Brazoria County br.) PLANS.—Approv. Feb. 12, 1894, 94, 428; approv. July 20, 1911, 12, 1300.

BRAZOS R., near Orchard, Tex. (S.) (Fort Bend County br.) PLANS.—Approv. July 20 1911, 12, 1300.

BRAZOS R., near Rosenberg, Tex. (S.) Fort Bend County br.) PLANS.—Approv. Feb. 6, 1908, 08, 871.

BRAZOS R., near Thompson, Tex. (S.) (Fort Bend County br.) PLANS.—Approv. July 20, 1911, 12, 1299.

BRAZOS R., near Wellborn, Tex. (S.) (Missouri Valley Br. & Iron Co.) PLANS.—Approv. Nov. 12, 1907, 08, 871.

BREACH INLET, between Sullivans Isld. and Long Isld., S. C. (S.) (Charleston Consolidated Ry., Gas & Electric Co. successors to the Charleston & Seashore R. R. Co.) PLANS.—Orig. company's plans approv. July 6, 1898, on condition that the drawspan be increased to 40′ w. by Mar. 1, 1899, 98, 536. Condition not complied with; company's request of Sept. 20, 1899, to be relieved of this requirement granted Nov. 29, 1899, 00, 700.

BRICES CREEK. (See Swift Creek.)

BRIDGEPORT, Conn. (See Coscob, etc.) (Dr.) 07, 815.

BRIDGEPORT H., Conn. (See Lewis Gut.)

BROAD CREEK, near Laurel, Del. (A.) (Philadelphia, Wilmington & Baltimore R. R. Co.) PLANS.—Alteration of br. draw made as required by act June 6, 1888, 90, 335. Reconstr. approv. Mar. 21, 1901, 01, 666.

BROAD CREEK R., near Laurel, Del. (S.) (Pennsylvania R. R. Co.) PLANS.—Reconstr. plans approv. Oct. 29, 1910, 11, 1084; and modification of instrument in name of Philadelphia, Baltimore & Washington R. R. Co., lessee of Delaware R. R. Co., approv. Nov. 29, 1910, 11, 1084.

BROAD CREEK, Va. (S.) (Elizabeth Park & Land Co.) PLANS.—Approv. Feb. 14, 1902, 02, 587. New plans approv. June 17, 1912, and instrument dated Feb. 14, 1902, revoked, 12, 1308.

BROAD R., near Columbia, S. C. (S.) (Columbia, Newberry & Laurens R. R. Co.) PLANS.—Reconstr. of existing br. approv. July 6, 1911, 12, 1299.

BRONX (or Harlem) **KILLS.** (See East R.)

BRONX R., Westchester Avenue, New York City. (S.) (City br.) PLANS.—Permanent and a temporary br. approv. Dec. 2, 1897, 98, 534. Approv. Jan. 30, 1901, in lieu of plans approv. Dec. 2, 1897, 01, 664.

BRONX R., Westchester Avenue, New York, N. Y. (S.) (Harlem R. & Port Chester R. R. Co., New York, New Haven & Hartford system.) PLANS.—Rebuilding approv. July 13, 1905, 06, 801.

BRONX R., below West Farms, N. Y. (S.) (Harlem R. & Portchester R. R. Co.) PLANS.—Reconstr. plans approv. May 17, 1893, 93, 469.

BUCKHANNON R. (See Ohio R., etc.)

BUFFALO BAYOU, Tex. (Sp.) (Galveston, La Porte & Houston Ry. Co.) LEGISLATION.—Company au. to constr. br. by act Feb. 1, 1895. PLANS.—Approv. Sept. 30, 1895, **96,** 422.

BUFFALO BAYOU, Houston, Tex. (S.) (City br.) PLANS.—Approv. Mar. 12, 1894, **94,** 428. Plans for a br. between Hill and Marsh Streets in lieu of the one above (to connect Factory and Bayou Streets), approv. Sept. 4, 1895, **96,** 424.

BUFFALO BAYOU, Houston, Tex. (O.) (Gulf, Colorado & Santa Fe Ry. Co.) PLANS.—Specified alterations to R. R. br. required on or before Oct. 11, 1892, **92,** 412.

BUFFALO BAYOU, near Houston, Tex. (O.) (San Antonio & Aransas Pass R. R. Co.) PLANS.—Specified alterations required in 1892, completed on or before Jan. 24, 1893, **93,** 473.

BUFFALO BAYOU, near Houston, Tex. (S.) (Harris County br.) PLANS.—Approv. Jan. 17, 1896, **96,** 425.

BUFFALO BAYOU, San Jacinto Street, Houston, Tex. (O.) (City br.) PLANS.—Specified alterations to highway br. required on or before Oct. 14, 1892, **92,** 412.

BUFFALO BAYOU, at Houston, Tex. (S.) (Houston Belt & Terminal Ry. Co.) PLANS.—Approv. May 10, 1910, **10,** 1030.

BUFFALO BAYOU, McKee Street, Houston, Tex. (S.) (Harris County br.) PLANS.—Approv. June 1, 1904, **04,** 719.

BUFFALO CREEK (R.), Ohio Street, Buffalo, N. Y. (S.) (City br.) PLANS.—Approv. July 13, 1904, **05,** 722.

BUFFALO CREEK, near Buffalo, N. Y. (S.) (Lake Shore & Michigan Southern Ry. Co.) PLANS.—Reconstr. of existing br. approv. July 8, 1911, **12,** 1299. New plans approv. Mar. 16, 1912, and instrument dated July 8, 1911, canceled, **12,** 1306.

BUFFALO CREEK, city of Buffalo, N. Y. (S.) (Buffalo Creek R. R.) PLANS.—Approv. Jan. 10, 1912, **12,** 1304.

BUFFALO LAKE, Packwaukee, Wis. (S.) (Packwaukee town br.) PLANS.—Approv. Aug. 22, 1905, **06,** 801.

BUFFALO LAKE (a portion of Fox R.), near Packwaukee, Wis. (S.) (Milwaukee, Sparta & Northwestern Ry. Co.) PLANS.—Approv. Aug. 12, 1910, and modified plans Jan. 26, 1911. **11,** 1082, 1086.

BUFFALO and **WHITE OAK BAYOUS,** at Houston, Tex. (S.) (City br.) PLANS.—Approv. Nov. 6, 1911, **12,** 1302.

BULLOCKS COVE (arm of Narragansett B.), R. I. (S.) (Hope Land Co.) PLANS.—Approv. Apr. 7, 1906, **06,** 805.

BURNHAMS CANAL, Milwaukee, Wis. (S.) (Chicago, Milwaukee & St. Paul Ry. Co.) PLANS.—Reconstr. approv. Nov. 23, 1906, **07,** 823.

BUSH R., Md. (S.) (Philadelphia, Baltimore & Washington R. R. Co., through the Pennsylvania R. R. Co.) PLANS.—Reconstr. existing br. approv. Mar. 19, 1912, **12,** 1306.

BUTLER (back) **R.,** Ga. (See Altamaha R.)

BUTTERMILK B., Bourne and Wareham, Mass. (S.) (Middleboro, Wareham & Buzzards B. Street Ry. Co.) PLANS.—Approv. July 18, 1901, **02,** 583.

C.

CABANOSSO (Grand) **BAYOU,** La. (S.) (Bowie Lumber Co., Ltd.) PLANS.—Approv. Aug. 7, 1906, **07,** 821.

CACHE R., Ark. (Dr.) **07,** 815.

CACHE R., Ark. (O.) (See Petit Jean R.) (Choctaw, Oklahoma & Gulf R. R. Co.) PLANS.—Specified alterations required on or before Aug. 1, 1900, **00,** 703.

CACHE R., Cottonplant, Ark. (S.) (Woodruff County br.) PLANS.—Approv. May 22, 1907, **07,** 827.

CACHE R., Woodruff County, Ark. (Sp.) (Missouri & North Arkansas R. R. Co.) Au. act Feb. 1, 1908. PLANS.—Approv. May 26, 1908, **08,** 868.

CACHE R., Woodruff County, Ark. (S.) (County br.) PLANS.—Approv. Jan. 26, 1911, **11,** 1086.

CAHABA R., in Bibb County, Ala. (Sp.) (Mobile & Ohio R. R. Co.) LEGISLATION.—Company au. to constr. br. by act June 11, 1896. PLANS.—Approv. June 16, 1897, **97,** 530.

CAHABA R., Ala. (8 and 16 m. above its mouth). (A.) (Selma & New Orleans R. R. and the Alabama Central R. R.) PLANS.—Descriptions of the brs., **88,** 2550. Both brs. fixed strs., impassable during the navigable stage of the R.; should have draw openings of 100′, **88,** 2551, 2553.

CALCASIEU R., Lake Charles, La. (S.) (Kansas City, Shreveport & Gulf Ry. Co.) PLANS.—Approv. Sept. 14, 1896, **97,** 531.

CALCASIEU R., La. (Dr.) **08,** 865.

CALCASIEU R., La. (S.) (Southern Pacific Co., on line of Louisiana Western R. R.) PLANS.—Approv. Feb. 10, 1903, **03,** 648.

CALCASIEU R., Calcasieu Parish, La. (S.) (Lake Charles & Northern R. R. Co.) PLANS.—Approv. Feb. 26, 1907, **07,** 825.

CALOOSAHATCHEE R., ferry crossing, Alva, Lee County, Fla. (S.) (Lee County br.) PLANS.—Approv. Dec. 18, 1902, **03,** 647.

CALOOSAHATCHEE R., Beautiful Isld., Fla. (S.) (Florida Southern R. R. Co.) PLANS.—Approv. Apr. 6, 1903, **03,** 649.

CALOOSAHATCHEE R., Denaud, Fla. (S.) (Lee County br.) PLANS.—Approv. May 8, 1907, **07,** 827.

CALOOSAHATCHEE R., Labelle, Fla. (S.) (Br. of Lee and De Sota Counties.) PLANS.—Approv. Oct. 28, 1908, **09,** 915.

CALUMET R., Ill. and Ind. (Dr.) **04,** 710; **05,** 719; **07,** 815.

CALUMET R., Ill. (A.) PLANS.—List of brs. forming an obstr. to the R., with changes suggested for each, **88,** 2583, 2650, 2651.

CALUMET R., Ill. (Sp.) (Hammond & Blue Isld. R. R. Co.) LEGISLATION.—Company au. to constr. br. by act Mar. 28, 1896. PLANS.—Modified plans approv. Aug. 11, 1896, **96,** 424.

CALUMET R., Ill. (S.) (Michigan Central R. R. Co.) PLANS.—For rebuilding approv. Oct. 28, 1902, **03,** 647.

CALUMET R., S. Chicago, Ill. (A.) (Baltimore & Ohio R. R. Co.) PLANS.—Reconstr. plans submitted Dec. 23, 1893; modified Jan. 26, 1894; approv. Mar. 1, 1894, **94,** 430. Change in location of p. requested Oct. 5, 1899; approv. Oct. 25, 1899, **00,** 699.

CALUMET R., S. Chicago, Ill. (Sp.) (Lake Shore & Michigan Southern R. R. Co.) LEGISLATION.—Company au. to reconstr. br. by act Mar. 3, 1893, **94,** 425. PLANS.—Submitted Dec. 23, 1893; modified Jan. 26, 1894; approv. Mar. 1, 1894, **94,** 425.

CALUMET R., S. Chicago, Ill. (Sp.) (Calumet & Blue Isld. Ry. Co.) LEGISLATION.—Company au. to constr. br. by act Mar. 1, 1893; amending act, June 8, 1894. PLANS.—Approv. Oct. 3, 1894. **95,** 473.

CALUMET R., 95th Street, Chicago, Ill. (S.) (City br.) PLANS.—Reconstr. plans approv. June 15, 1900, **00,** 701.

CALUMET R., Chicago, Ill. (Sp.) (Chicago & Western Indiana R. R. Co.) Au. act Aug. 5, 1909. PLANS.—Approv. Sept. 14, 1909, **10,** 1020.

CALUMET R., in Chicago, Ill. (O.) (Pennsylvania, Lake Shore & Michigan Southern, and Baltimore & Ohio R. R. Cos.) PLANS.—Alterations to be completed on or before 2 years from Feb. 23 and 25, and Mar. 18, 1910, **10,** 1031.

CALUMET R., 92d Street, Chicago, Ill. (Sp.) (City br.) PLANS.—For br. to replace existing str. approv. Nov. 12, 1908, **09,** 913.

CALUMET R., near E. Chicago and Gary, Ind. (Sp.) (Chicago, Lake Shore & South Bond Ry. Co.) Au. act Feb. 5, 1907. PLANS.—Approv. Feb. 16, 1907, **07,** 818.

CALUMET R., near the forks, Cook County, Ill. (Sp.) (Kensington & Eastern R. R. Co.) Au. act Feb. 7, 1905, and Mar. 5, 1906. PLANS.—Approv. Dec. 18, 1906, **07,** 818.

CALUMET R., Cummings, Ill. (Sp.) (New York, Chicago & St. Louis R. R. Co.) Au. act July 1, 1902. PLANS.—To replace existing str. approv. Jan. 15, 1903, **03,** 643, 644.

CALUMET R., near Gary, Ind. (Sp.) (Chicago, Lake Shore & Eastern Ry. Co.) Au. act Mar. 3, 1909. PLANS.—Approv. Apr. 26, 1909, **09,** 913.

CALUMET R., near Hyde Park (now annexed to the city of Chicago), Ill. (A.) PLANS.—Wagon-road br. across the R. obliquely, **89,** 2799.

CALUMET R., Ill., near the Illinois and Indiana State line. (A.) (Chicago & Calumet R. R. Co.) PLANS.—Chicago & Calumet R. R. br., upon completion of the Calumet R. imp. as projected, would have 1 draw span that could not be used at all, and the other would be contracted to 59′, which is too narrow, **89,** 2799.

CALUMET (Little Calumet) **R.,** Riverdale, Ill. (S.) (Pittsburgh, Cincinnati, Chicago & St. Louis Ry. Co.) PLANS.—Approv. Feb. 14, 1899, **99,** 622.

CALUMET R., Hammond, Ind. (S.) (Chicago, Indianapolis & Louisville Ry. Co.) PLANS.—Reconstr. plans for the superstr. and strengthening abutments approv. Aug. 2, 1899, **99,** 623.

CALUMET R., Columbia Avenue, Hammond, Ind. (Sp.) (Lake County br.) Au. act Feb. 5, 1907. PLANS.—Approv. Mar. 12, 1907, **07,** 818.

CALUMET R., Hammond, Ind. (Sp.) (New York, Chicago & St. Louis R. R. Co., and Chicago & Erie R. R. Co.) Au. act July 1, 1902. PLANS.—Approv. Nov. 18, 1903, **04,** 711.

CALUMET R., Hammond, Ind. (Sp.) (Chicago, Indianapolis & Louisville R. R. Co.) Au. act Feb. 20, 1908. PLANS.—Reconstr. approv. July 29, 1908, **09,** 912.

CALUMET (Little Calumet) **R.,** Riverdale, Ill. (S.) (Illinois Central R. R. Co.) PLANS.—Approv. Jan. 30, 1901, **01,** 664.

CALUMET (Grand) **R.,** Ind. (Sp.) (Gary Land Co.) Au. act June 16, 1910. PLANS.—Approv. Sept. 12, 1910, **11,** 1079. (Possibly 2 separate brs. under this head.)

CALUMET (Grand) **R.,** Ind. (Township 36). (Sp.) (Gary Land Co.) PLANS.—Approv. Sept. 12, 1910, **11,** 1079.

CAMBRIDGE H., Cambridge, Md. (S.) (Dorchester County br.) PLANS.—Alteration plans approv. July 11, 1894, **94,** 429.

CANE R., at Bermuda, Natchitoches Parish, La. (S.) (Police jury br.) PLANS.—Approv. June 8, 1911, **11,** 1090.

CANE R., Derry Station, La. (S.) (Natchitoches Parish br.) PLANS.—Approv. May 12, 1904, **04,** 718.

CANE R., at Natchitoches, La. (Sp.) (Natchitoches Cane R. Br. Co.) LEGISLATION.—Constr. au. by act Apr. 22, 1890; amending act Jan. 9, 1893, **93,** 465. PLANS.—Approv. July 1, 1893, **93,** 465.

CANEY FORK R., Ballards Ferry, Tenn. (S.) (Carthage & Granville Br. Co.) PLANS.—Approv. Mar. 6, 1907, **07,** 825.

CANEY FORK R., Buffalo Valley, Tenn. (S.) (Southern Ry. Co.) PLANS.—Reconstr. approv. Dec. 11, 1906, **07,** 824.

CANEY FORK R., Smith and Putham Counties, Tenn. (Sp.) (Nashville & Knoxville R. R. Co.) LEGISLATION.—Au. by acts Mar. 3, 1885; amended Feb. 25, 1889. PLANS.—Plan and location submitted, and approv. by Sec. of War, Dec. 12, 1889, **90,** 337.

CANEY FORK R., near Trousdale Ferry, Tenn. (S.) (Caney Fork br.) PLANS.—Approv. July 26, 1904, **05,** 722.

CANOE PASS. (See Deception Pass.)

CAPE FEAR R., N. C. (See Northeast R.)

CAPE FEAR R., Fayetteville, N. C. (Sp.) (Yadkin Valley Ry. Co.) LEGISLATION.—Company au. to constr. br. by act June 6, 1888. PLANS.—Approv. Dec. 1, 1888, **89,** 369.

CAPE FEAR R., Navassa, N. C. (S.) (Wilmington Ry. Br. Co.) PLANS.—Reconstr. plans approv. Aug. 20, 1898, **98,** 537.

CAPE FEAR R., at Navassa Guano Factory, N. C. (O.) (Wilmington Ry. Br. Co.) PLANS.—Alterations to be completed on or before 1 year from June 27, 1910, **10,** 1032.

CAPE FEAR R. (NE. branch), Hilton, N. C. (S.) (Wilmington Ry. Br. Co.) PLANS.—Reconstr. plans approv. Aug. 20, 1898, **98,** 537.

CAPE FEAR R. (NE.), above Wilmington, N. C. (A.) (Wilmington, Columbia & Augusta R. R. Co.) PLANS.—Capt. Bixby recom. the removal of a sunken p. obstr. the draw, at the expense of the U. S., and that the R. R. be required to provide suitable fenders for the draw opening, **88,** 2547.

CAPE FEAR R. (NE.), above Wilmington, N. C. (A.) (Wilmington & Weldon R. R. Co.) PLANS.—Capt. Bixby recom. that the owners be required to provide br. with suitable draw 40′-60′ wide, **88,** 2547.

CAPE ISLD. CREEK, at Schellingers Landing, N. J. (S.) (Cape May County br.) PLANS.—To replace existing br. approv. Feb. 25, 1910, **10,** 1028.

CAPE JELLISON H., Stockton Springs, Me. (S.) (Northern Maine Seaport Ry. Co.) PLANS.—Approv. June 27, 1905 **05,** 728.

CAPE NEDDICK R., York, Me. (S.) (Atlantic Shore Line Ry. Co.) PLANS.—Approv. Nov. 21, 1906, **07,** 823.

CASCO B., between Cousins and Littlejohns Islds., Me. (S.) (Yarmouth br.) PLANS.—Plans submitted May 10, 1895; approv. May 8, 1897, **97,** 534.

CASPER (Gasper) **R.,** near its mouth, Ky. (O.) (Warren County br.) PLANS.—Br. to be raised 6′, to make its clear height above pool level 24.6′, on or before July 1, 1892, **92,** 411.

CEDAR CREEK, at Lake Side Park, Jacksonville, Fla. (S.) (Johnson & Hyde.) PLANS.—Approv. June 25, 1910, **10,** 1031.

CERRITOS SLOUGH, Long Beach, Cal. (S.) (Los Angeles Dock & Terminal Co.) PLANS.—Approv. Aug. 22, 1906, **07,** 821.

CERRITOS SLOUGH, Long Beach, Cal. (S.) (San Pedro, Los Angeles & Salt Lake R. R. Co.) PLANS.—For reconstr. approv. Nov. 7, 1906, **07,** 823.

CERRITOS SLOUGH, Long Beach, Cal. (S.) (Los Angeles Interurban Ry. Co.) PLANS.—Two trestle brs. approv. Jan. 19, 1910, **10,** 1026.

CHARLES R., Mass. (O. and A.) COMMERCE.—C. interests affected, **90,** 3474. Chief of Engineers. **R.,** **90,** 340. BE. Convened at Boston, Mass., Feb. 1, 1890, by S. O. No. 82, to report upon the brs. crossing Charles R. which interfered with navigation. Draw openings of the Charles R. and Warren brs. of insufficient width. **90,** 3482. Descriptions of existing brs., **90,** 3471, 3474. LEGISLATION.—Notices served upon br. owners as to alterations required, **90,** 340.

CHARLES R., between the R. mouth and E. Cambridge. (A.) (Boston & Maine and the Eastern and Boston & Lowell R. Rs.) PLANS.—Delays in opening draws, caused by frequent passage of trains, not to be obviated by any practical alteration of the brs., **88,** 2528.

CHARLES R., Boston and Cambridge, Mass. (S.) (Boston & Maine R. R. Co.) PLANS.—Alterations submitted Jan. 31, 1893; approv. Feb. 3, 1893, on condition that in 10 years the company rebuild on st. or iron ps. all its brs. over Charles R., **93,** 467. Reconstr. approv. Sept. 15, 1904, **05,** 724.

CHARLES R. (W. Boston br.), between Boston and Cambridge, Mass. (S. and Sp.) (Cambridge city br.) LEGISLATION.—City au. to constr. new br. by act Mar. 29, 1900, **00,** 697. PLANS.—For temporary br. to be used during reconstr. of W. Boston br., approv. Sept. 14, 1898, **99,** 620. Plans for a drawless br. to replace existing str. approv. June 5, 1900, **00,** 697.

CHARLES R., Boston, Mass. (O.) (Boston & Maine R. R. Co.; Eastern R. R. Co., controlled by Boston & Maine R. R. Co.; and Boston & Lowell R. R. Co., controlled by Boston & Maine R. R. Co.) PLANS.—Alterations to 4 R. R. brs. required by Jan. 1, 1891, **89,** 375.

CHARLES R., Boston, Mass. (S.) (Boston Transit br.) PLANS.—Reconstr. plans approv. Dec. 27, 1895, **96,** 425.

CHARLES R., at Boston, Mass. (O.) (Charles R. br. and Warren br.) PLANS.—Alterations required by Jan. 1. 1891, **89,** 375.

CHARLES R., Boston (city limits). (O.) (Fitchburg R. R. Co.) PLANS.—Alterations required by Jan. 1, 1891, **89,** 374.

CHARLES R., Boston, Mass. (S.) (State br.) PLANS.—For temporary br. on site of Boston & Maine R. R. br., approv. Sept. 1, 1904, **05,** 723.

CHARLES R., Market and Arsenal Streets, Boston, Mass. (Sp.) (City br.) LEGISLATION.—City au. to reconstr. brs. under act Sept. 19, 1890. PLANS.—For rebuilding the drawways approv. July 20, 1892, **92,** 407.

CHARLES R., W. Boston, Mass. (O.) (W. Boston br., and canal, or Craigies br.) PLANS.—Alterations required by Jan. 1, 1891. **89,** 375, 376.

CHARLES R., Cambridge and Boston, Mass. (S.) (Cambridge city br.) PLANS.—Approv. May 27, 1905, **05,** 727.

CHARLES R., at Brookline Street, Cambridge, and Essex Street, Boston, Mass. (S.) (Cambridge City br.) PLANS.—For rebuilding approv. Dec. 10, 1904, **05,** 725.

CHARLES R., Boston and Cambridge, Mass. (S.) (New York Central & Hudson R. R. R. Co., lessee of Boston & Albany R. R.) PLANS.—For rebuilding approv. Dec. 10, 1904, **05,** 725.

CHARLES R., Boston and Cambridge, Mass. (S.) (Boston Elevated Ry. Co.) PLANS.—Approv. Aug. 15, 1907, **08,** 869.

CHARLES R., between Boston and Cambridge, Mass. (Sp.) (Metropolitan Park Commission, Mass.) Au. act Feb. 27, 1911. PLANS.—Approv. Apr. 24, 1912, **12,** 1298.

CHARLEVOIX H., Mich. (Dr.) **12,** 1294.

CHARLEVOIX H., Mich., between Round Lake and Lake Michigan. (A.) (Iron highway br.) PLANS.—No complaints made, although delay sometimes caused in opening the draw, from slowness, **89,** 2800.

CHARTIERS CREEK, McKees Rocks, Pa. (S.) (George Orbin Br. Co.) PLANS.—Approv. May 27, 1907, **07,** 827.

CHATTAHOOCHEE R., Ala. (Dr.) **06,** 797.

CHATTAHOOCHEE R., Alaga, Ala. (Sp.) (Atlantic Coast Line R. R. Co.) Au. act Aug. 6, 1888. PLANS.—For reconstr. approv. May 24, 1911; new plans approv. Oct. 31, 1911, **11,** 1081; **12,** 1297, 1302.

CHATTAHOOCHEE R., Columbia, Ala. (Sp.) (City br.) LEGISLATION.—City au. to constr. br. by act Apr. 16, 1896. PLANS.—Modified plans approv. June 9, 1896, **96,** 423.

CHATTAHOOCHEE R., Eufaula and Fort Gaines, Ga. and Ala. (A.) (2 wagon brs. and the Southwestern R. R. br.) PLANS.—Introduction of a draw of suitable width with sheer booms recom. in each case, **88,** 2553.

CHATTAHOOCHEE R., at or near Gordon, Ala. (Sp.) (Alabama Midland Ry. Co.) LEGISLATION.—Company au. to constr. br. by act Aug. 6, 1888. PLANS.—Approv. June 12, 1889, **89,** 372.

CHAUMONT R., near Chaumont, N. Y. (O.) (New York Central & Hudson R. R. R. Co.) PLANS.—Specified alterations to be completed within 9 months from Oct. 25, 1901; time extended to Apr. 1, 1903, **02,** 590.

CHAUMONT R., near its mouth, N. Y. (O.) (New York Central & Hudson R. R. R. Co., and the city of Lyme, N. Y.) PLANS.—Alterations to be completed on or before June 15, 1910, **10**, 1031.

CHEEHAN R. (See Ashley R.)

CHEAT R., Pt. Marion, Pa. (S.) (State Line R. R. Co.) PLANS.—Approv. Sept. 24, 1892, **93**, 466.

CHEAT R., Pt. Marion and Springhill, Pa. (S.) (Fayette County br.) PLANS.—Approv. Mar. 26, 1907, **07**, 826. Modified plans in lieu thereof approv. Aug. 21, 1907, **08**, 869.

CHEBOYGAN R., near Cheboygan, Mich. (S.) (Detroit & Mackinac Ry. Co.) PLANS.—Approv. Mar. 23, 1904, **04**, 717.

CHEESEQUAKE CREEK, N. J. (S.) (Jersey Central Traction Co.) PLANS.—Approv. June 27, 1903, **03**, 650.

CHEESEQUAKE CREEK, near its mouth, N. J. (S.) (Middlesex County br.) PLANS.—Reconstr. plans approv. Apr. 7, 1911, **11**, 1088.

CHEF MENTEUR PASS, La. (O.) (Louisville & Nashville R. R. Co.) PLANS.—Alterations to be completed on or before 6 months from Sept. 3, 1910, **11**, 1091.

CHEHALIS R., between Aberdeen and Cosmopolis, and Johns R., near its confluence with Grays H., Wash. (Sp.) (Tacoma, Olympia & Grays H. Co.) LEGISLATION.—Company au. to constr. brs. under act Sept. 19, 1890, sec. 7, and act of Washington. PLANS.—For the 2 brs. approv. Feb. 9, 1891, **91**, 430.

CHEHALIS R., Aberdeen, Wash. (S.) (City br.) PLANS.—Approv. Nov. 19, 1903, **04**, 715.

CHEHALIS R., Aberdeen, Wash. (S.) (Grays Harbor & Puget Sound Ry. Co.) PLANS.—Approv. June 20, 1907, **07**, 828. Modified plans in lieu thereof approv. Dec. 9, 1907, **08**, 871. New plans, Jan. 19, 1910, **10**, 1026.

CHEHALIS R., near Centralia, Wash. (S.) (Grays Harbor & Puget Sound Ry. Co.) PLANS.—Approv. Dec. 23, 1908, **09**, 916.

CHEHALIS R., Elbow Riffle, Chehalis County, Wash. (County br.) LEGISLATION.—County au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Washington, **92**, 405. PLANS.—Approv. May 14, 1892, **92**, 405. Reconstr. approv. Apr. 2, 1904, **04**, 717.

CHEHALIS R., at Montesano and Wynooche, Wash. (S.) (Chehalis County br.) PLANS.—Approv. May 27, 1910, and modified plans approv. July 19, 1910, **10**, 1030; **11**, 1082.

CHEHALIS R., near Montesano, Wash. (S.) (Oregon-Washington R. R. & Navigation Co.) PLANS.—Approv. June 7, 1912, **12**, 1307.

CHEHALIS R., Porter, Wash. (S.) (Chehalis County br.) PLANS.—Approv. July 31, 1905, **06**, 801.

CHAHALIS R., near Rochester, Wash. (S.) (Chicago, Milwaukee & Puget Sound Ry. Co.) PLANS.—Approv. Feb. 16, 1910, **10**, 1027.

CHELSEA CREEK, Chelsea Street, Boston, Mass. (S.) (Boston city br.) PLANS.—For rebuilding br. approv. May 7, 1894, **94**, 428.

CHELSEA CREEK, Boston to Chelsea, Mass. (S.) (Boston & Albany R. R. Co.) PLANS.—Reconstr. approv. July 28, 1900, **01**, 662.

CHELSEA CREEK, Boston and Chelsea, Mass. (S.) (Boston & Albany R. R. Co., New York Central & Hudson R. R. R. Co., lessee.) PLANS.—Rebuilding approv. June 16, 1908, **08**, 873.

CHELSEA CREEK, Boston and Chelsea, Mass. (S.) (City br.) PLANS.—Reconstr. approv. June 29, 1908, **08**, 873.

CHELSEA CREEK, at Meridian Street, Boston, Mass. (S.) (City br.) PLANS.—Reconstr. of existing br. approv. July 20, 1911, **12**, 1300.

CHEVRENIL BAYOU and **BAY OF CHEVRENIL**, opposite Thibodeaux, La. (S.) (Brs. of Highway Department, La.) PLANS.—Approv. July 1, 1911, **12**, 1299.

CHESTER CREEK. (See Schuylkill R.)

CHICAGO R., Ill. (Dr.) **07**, 815.

CHICAGO R., Canal Street, Chicago, Ill. (O.) BE.—Convened by S. O. No. 39, to ex. and R. on br., recom. (1) removal of the pivot p., the protection wings or br. rests, and all the adjuncts obstr. navigation; (2) postponement of further constr. until the R. should have been so widened as to provide for the full opening of the s. draw; (3) provision be made when the br. is restored for maneuvering it by steam power, **91**, 3864. (Majs. Ludlow and Davis and Capt. Marshall.) PLANS.—Alterations required by May 1, 1892, **91**, 436.

CHICAGO R., Chicago, Ill. (O.) (Illinois Central R. R. Co.) PLANS.—Alterations to be completed on or before Apr. 15, 1904; subsequently extended to July 15, 1904, **04**, 721.

CHICAGO R., Dearborn Street, Chicago, Ill. (S.) (City br.) PLANS.—Approv. Dec. 27, 1905, **06**, 803.

CHICAGO R., Harrison Street, Troop Street, and Ashland Avenue, Chicago, Ill. (S.) (Brs. of Sanitary District.) PLANS.—Reconstr. approv. Sept. 14, 1900, **01**, 662.

CHICAGO R., 19th Street, Chicago, Ill. (S.) (Pittsburgh, Fort Wayne & Chicago R. R. Co.) PLANS.—Approv. Apr. 17, 1907; modified plans approv. Dec. 15, 1908, **09**, 916.

CHICAGO R., Orleans and Franklin Streets, Chicago, Ill. (S.) (City br.) PLANS.—Approv. July 23, 1907, **08**, 868.

CHICAGO R., State Street, Chicago, Ill. (S.) (City br.) PLANS.—Approv. Oct. 28, 1902, **03**, 646, 647.

CHICAGO R., Wells Street br. (e. of), Chicago, Ill. (S.) (Lake Street Elevated R. R. Co.) PLANS.—Approv. July 13, 1894, **94**, 429.

CHICAGO R., Wells Street (e. of), Chicago, Ill. (S.) North Western Elevated R. R. Co.) PLANS.—Submitted Apr. 21, 1894; modified May 24, 1894; approv. June 2, 1894, **94**, 428.

CHICAGO R., N. Branch, near Belmont Avenue, Chicago, Ill. (City br.) PLANS.—Temporary

br. approv. Apr. 25, 1911, and modified plans approv. May 13, 1911, **11**, 1089.

CHICAGO R., N. Branch, Cherry Street, Chicago, Ill. (S.) (Chicago, Milwaukee & St. Paul Ry. Co.) PLANS.—Reconstr. approv. Feb. 19, 1901, **01**, 665.

CHICAGO R., N. Branch, at Chicago Avenue, Chicago, Ill. (O.) (S.) (City br.) PLANS.—Alterations to be completed on or before May 31, 1914, **11**, 1091. Temporary br., during reconstr. of existing br., approv. July 10, 1911, **12**, 1299.

CHICAGO R., N. Branch, Clybourne Place (near), Chicago, Ill. (S.) (Chicago, Milwaukee & St. Paul Ry. Co.) PLANS.—Reconstr. plans approv. Sept. 20, 1898, **99**, 620.

CHICAGO R., N. Branch, Clybourne Street, Chicago, Ill. (S.) (City br.) PLANS.—Approv. Oct. 23, 1900, **01**, 663.

CHICAGO R., N. Branch, Diversey Avenue, Chicago, Ill. (S.) (Chicago city br.) PLANS.—Approv. June 22, 1895, **95**, 479.

CHICAGO R., N. Branch, Division Street, Chicago, Ill. (S.) (Chicago city br.) PLANS.—Reconstr. approv. July 28, 1900, **01**, 662; May 10, 1901, **01**, 666.

CHICAGO R., N. Branch, Erie Street, Chicago, Ill. (S.) (City br.) PLANS.—Approv. Aug. 15, 1907, **08**, 869.

CHICAGO R., N. Branch, Fullerton Avenue, Chicago, Ill. (S.) (Chicago city br.) PLANS.—Reconstr. of br. approv. June 19, 1895, **95**, 479.

CHICAGO R., N. Branch, Indiana Street, Chicago, Ill. (O.) (City br.) PLANS.—Alterations to be completed on or before May 30, 1912, **09**, 920; **10**, 1031.

CHICAGO R., N. Branch, near Indiana Street, Chicago, Ill. (S.) (City br.) PLANS.—For foot pontoon br. approv. Sept. 25, 1911, **12**, 1301.

CHICAGO R., N. Branch, Kinzie Street (near), Chicago, Ill. (Sp.) (Chicago & North Western Ry. Co.) LEGISLATION.—Company au. to constr. br. under act Sept. 19, 1890, sec. 7, and by Chicago, **91**, 432. PLANS.—Approv. Aug. 3, 1891, **91**, 432. Reconstr. approv. Oct. 11, 1906 **07**, 822.

CHICAGO R., N. Branch, near Kinzie Street, Chicago, Ill. (S.) (Chicago, Milwaukee & St. Paul Ry. Co.) PLANS.—Reconstr. approv. Oct. 11, 1906, **07**, 822.

CHICAGO R., N. Branch, near Kinzie Street, Chicago, Ill. (S.) (City br.) PLANS.—Reconstr. approv. Oct. 12, 1906, **07**, 822.

CHICAGO R., N. Branch, North Avenue, Chicago, Ill. (S.) (City br.) PLANS.—Approv. June 22, 1904, **04**, 719. Temporary br. to be used during constr. of permanent str., approv. Sept. 2, 1905, **06**, 801.

CHICAGO R., N. Branch, N. Halsted Street, Chicago, Ill. (S.) (City br.) PLANS.—Modified reconstr. plans approv. Oct. 3, 1895, **96**, 425.

CHICAGO R., N. Branch, Western Avenue, Chicago, Ill. (S.) (City br.) PLANS.—Approv. Oct. 11, 1902, **03**, 646.

CHICAGO R., N. Branch Canal, N. Halsted Street, Chicago, Ill. (S.) (City br.) PLANS.—Approv. June 23, 1905; modified plans approv. Nov. 20, 1906, **05**, 728; **07**, 823.

CHICAGO R., N. Branch Canal, Weed Street, Chicago, Ill. (S.) (Temporary city br.) PLANS.—Approv. Dec. 7, 1904, **05**, 725.

CHICAGO R., S. Branch, Chicago, Ill. (S.) (Van Buren Street and the West Side Elevated R. R. Co., between Jackson and Van Buren Streets, city brs. at.) PLANS.—Submitted conjointly by the city and R. R. company. Hearing given protesting parties, and in accordance with recom. of Capt. Marshall the city br. at Van Buren Street was au. Nov. 16, 1893, to be reconstr. and the R. R. br., upon removal of obstrs. caused by the existing Van Buren Street br., to be constr. Application for a slight change in the approv. location of ps. approv. Mar. 27, 1894. **94**, 427.

CHICAGO R., S. Branch, Archer Avenue, Chicago, Ill. (S.) (City br.) PLANS.—Rebuilding approv. Oct. 30, 1902; modified plans approv. May 10, 1904, **04**, 718.

CHICAGO R., S. Branch, Canal Street, Chicago, Ill. (S.) (City br.) PLANS.—New br. approv. May 18, 1900, **00**, 701.

CHICAGO R., S. Branch, 18th Street and at Loomis Street, Chicago, Ill. (S.) (City br.) PLANS.—Reconstr. approv. Mar. 7, 1903, **03**, 649.

CHICAGO R., S. Branch, Harrison Street, Chicago, Ill. (S.) (City br.) PLANS.—Modified plans approv. Sept. 13, 1904, **05**, 724.

CHICAGO R., S. Branch, Lake Street, Chicago, Ill. (O.) (City br.) PLANS.—Alterations to be completed before Dec. 31, 1912, **09**, 920; **10**, 1031.

CHICAGO R., S. Branch, Loomis Street, Chicago, Ill. (S.) (Sanitary District br.) PLANS.—Plans for br. to replace existing str. approv. June 23, 1902, **02**, 589.

CHICAGO R., S. Branch, near 19th Street, Chicago, Ill. (A.) (Pittsburgh, Fort Wayne & Chicago R. R. Co.—Controlled by the Pennsylvania R. R. Co.) PLANS.—Alteration plan partly meeting requirements, approv. Feb. 11, 1893; work to be completed by May 1, 1893, **93**, 472.

CHICAGO R., S. Branch, Polk Street, Chicago, Ill. (S.) (City br.) PLANS.—Approv. Nov. 26, 1907, **08**, 871.

CHICAGO R., S. Branch, Randolph Street, Chicago, Ill. (S.) (City br.) PLANS.—Approv. Oct. 20, 1902, **03**, 646.

CHICAGO R., S. Branch, near 16th Street, Chicago, Ill. (O.) (St. Charles Air Line.) PLANS.—Alterations to be completed on or before May 1, 1914, **12**, 1309.

CHICAGO R., S. Branch, S. Halsted Street, Chicago, Ill. (S.) (City br.) PLANS.—Approv. Jan. 13, 1893, **93**, 467.

CHICAGO R., S. Branch, at Stewart Avenue, Chicago, Ill. (Pennsylvania Co.—Operating

Pittsburgh, Fort Wayne & Chicago Ry. Co.) Reconstr. approv. Apr. 17, 1907, **07,** 826. PLANS.—Modified plans approv. Dec. 15, 1908. New plans approv. Aug. 21, 1911, and instrument dated Dec. 15, 1908, revoked, **12,** 1301.

CHICAGO R., S. Branch, Taylor Street, Chicago, Ill. (S.) (City br.) PLANS.—Reconstr. plans approv. Mar. 10, 1899, **99,** 622.

CHICAGO R., S. Branch, Taylor Street (s. of), Chicago, Ill. (S.) (Chicago Terminal Transfer Ry. Co.) PLANS.—Reconstr. plans approv. Jan. 13, 1899. Old br. removed to new site and used pending reconstr., **99,** 622.

CHICAGO R., S. Branch, at 12th Street, Chicago, Ill. (O.) (City br.) PLANS.—Alterations to be completed Dec. 31, 1912, **11,** 1091.

CHICAGO R., S. Branch, 22d Street, Chicago, Ill. (S.) (City br.) PLANS.—Permanent br. to replace existing str., approv. July 14, 1904. Plans for temporary br. approv. May 2, 1905. Revised plans approv. May 22, 1905, **05,** 727.

CHICAGO R., S. Branch, at Washington Street, Chicago, Ill. (S.) (City br.) PLANS.—Approv. Mar. 3, 1911, **11,** 1087.

CHICAGO R., S. Branch (s. fork of), Chicago, Ill. (O.) (Illinois Central R. R. Co., Chicago & Alton R. R. Co., and Atchison, Topeka & Santa Fe Ry. Co.) PLANS.—Alterations to be completed on or before Apr. 1, 1905, **04,** 720.

CHICAGO R., S. Branch (s. fork of), Chicago, Ill. (S.) (City br.) PLANS.—Approv. Sept. 14, 1908, **09,** 915.

CHICAGO R., S. Branch (s. fork of), Archer Avenue, Chicago, Ill. (S.) (City br.) PLANS.—Reconstr. plans approv. Nov. 2, 1897, **98,** 533; and Oct. 30, 1902, **03,** 647.

CHICAGO R., S. Branch (s. fork of), Iron Street and Center Avenue, and temporary br. at W. 39th Street, Chicago, Ill. (S.) (Brs. of Chicago Junction Ry. Co.) PLANS.—Approv. July 20, 1906, **07,** 820.

CHICAGO R., S. Branch (s. fork of), 35th Street, Chicago, Ill. (S.) (City br.) PLANS.—Approv. Sept. 14, 1908, and modified plans approv. Feb. 28, 1911, and plans for temporary br. alongside existing br. approv. May 8, 1911, **11,** 1087, 1089.

CHICAGO R., S. Branch (w. arm of s. fork of), Ashland Avenue, Chicago, Ill. (S.) (City br.) PLANS.—Approv. Mar. 20, 1907, **07,** 826.

CHICAGO R., S. Branch (w. fork of), Southwest Boulevard, Chicago, Ill. (Sp., etc.) (City br.) LEGISLATION.—City au. to constr. br. under act Sept. 19, 1890, sec. 7, and by act Illinois. PLANS.—Approv. June 21, 1892, **92,** 406.

CHICAGO R., S. Branch (w. fork of), Chicago, Ill. (S.) (Chicago & Northern Pacific R. R. Co.) PLANS.—Approv. Feb. 15, 1893, **93,** 467.

CHICAGO R., S. Branch (w. fork of), Chicago, Ill. (S.) (Cincinnati, Chicago & St. Louis Ry. Co.) PLANS.—Rebuilding approv. Nov. 12, 1900, **01,** 663.

CHICAGO R., S. Branch (w. fork of), Central Park Avenue, Chicago, Ill. (S.) (Illinois & Northern Ry. Co.) PLANS.—Reconstr. approv. Feb. 23, 1907, **07,** 825.

CHICAGO R., S. Branch (w. fork of), Hamlin Avenue, Chicago, Ill. (S.) (Chicago & Illinois Western R. R. Co.) PLANS.—Approv. Apr. 13, 1906, **06,** 805.

CHICAGO R., S. Branch (w. fork of), Southwestern Avenue, Chicago, Ill. (S.) (City br., temporary.) PLANS.—Approv. Mar. 31, 1905, **05,** 726.

CHICKASAHAY R., Averas Crossing, Miss. (S.) (Green County br.) PLANS.—Approv. Nov. 3, 1906, **07,** 823.

CHICKASAHAY R., near Boice Station, Miss. (S.) (Mobile & Ohio R. R. Co.) PLANS.—Approv. Feb. 9, 1906, **06,** 804.

CHICKASAHAY R., near Leakesville, Miss. (S.) (Green County br.) PLANS.—Approv. Apr. 25, 1902, **02,** 588.

CHICKASAHAY R., at Leakesville, Miss. (S.) (Alabama & Mississippi R. R. Co.) PLANS.—Approv. July 16, 1902, **03,** 645.

CHICKASAHAY R., Millers Ferry, Miss. (S.) (Breen County br.) PLANS.—Approv. Mar. 18, 1907, **07,** 826.

CHICKASAW CREEK, Ala. (Dr.) **08,** 865.

CHINCOTEAGUE and DELAWARE BS. (canal between), Del. (A.) (Sussex County, temporary br.) PLANS.—Au. to constr. temporary br. granted June 20, 1894, by revocable license. License revoked Sept. 8, 1894. **94,** 430.

CHINOOK R., Pacific County, Wash. (S.) (Pacific County br.) PLANS.—Approv. Nov. 5, 1902, **03,** 647.

CHIPOLA R., near Clarksville, Fla. (O.) (Calhoun County br.) PLANS.—Alterations to be completed on or before 12 months from Nov. 7, 1908, **09,** 919.

CHIPOLA R., Peacock's log landing, Fla. (S.) (Jackson County br.) PLANS.—Approv. Jan. 8, 1902, **02,** 586.

CHIPPEWA R. (See St. Croix R.)

CHIPPEWA R., Durand, Wis. (A.) (Highway.) Engineer in charge: Maj. C. J. Allen. PLANS.—Maj. Allen reported that sheer booms should be placed to assist vessels in passing the spans, **88,** 2637.

CHIPPEWA R., Durand, Wis. (O.) (Chippewa Valley Br. Co.) PLANS.—Specified alterations to highway br. required on or before June 16, 1892. Time extended to Dec. 15, 1892. **92,** 412.

CHIPPEWA R., Durand, Wis. (S.) (City br.) PLANS.—Approv. Jan. 7, 1902, **02,** 586.

CHIPPEWA R., at Eau Claire, Wis. (S.) (Chicago, St. Paul, Minneapolis & Omaha Ry. Co.) PLANS.—Approv. Oct. 30, 1911, **12,** 1302.

CHIPPEWA R., near Red Cedar, Wis. (Sp., etc.) (Chicago, Milwaukee & St. Paul Ry. Co.) LEGISLATION.—Company au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Wisconsin. PLANS.—For new br. approv. Apr. 16, 1892, **92,** 404.

CHITINA R. (See Copper R.)

CHOCOLATE BAYOU, Tex. (S.) (See Bastrop Bayou.) (Galveston, Brazos & Southwestern Ry. Co.) PLANS.—Approv. Nov. 22, 1897, **98,** 534.

CHOCOLATE BAYOU, Tex. (S.) (St. Louis, Brownsville & Mexico Ry. Co.) PLANS.—Approv. Oct. 6, 1905, **06,** 892.

CHOCOLATE BAYOU, near Rowanville, Tex. (S.) (Brazoria County br.) PLANS.—Approv. Aug. 4, 1911, **12,** 1300.

CHOCTAW BAYOU, W. Baton Rouge Parish, La. (S.) (Morgan's Louisiana & Texas R. R. & S. S. Co.) PLANS.—Approv. Aug. 17, 1906, **07,** 821.

CHOCTAWHATCHEE R., near Bellwood, Ala. (O.) (Central of Georgia Ry. Co.) PLANS.—Alterations to be completed by Dec. 31, 1908, **08,** 873.

CHOCTAWHATCHEE R., Geneva, Ala. (Sp.) (Louisville & Nashville R. R. Co.) Au. act Feb. 23, 1901. PLANS.—Approv. July 12, 1901, **02,** 581.

CHOCTAWHATCHEE R., N. J. (Dr.) **06,** 797.

CHOCTAWHATCHEE R., near Geneva and below Newton, Ala. (A.) (Wagon brs.) PLANS.—Both brs. should be removed if R. imps. be carried out, **88,** 2553.

CHOCTAWHATCHEE R., near Martins Ferry, Ala. (Sp.) (Geneva County br.) Au. act Mar. 3, 1903. PLANS.—Approv. July 30, 1903, **04,** 711.

CHOCTAWHATCHEE R., near Newton, Ala. (Sp.) (Dale County br.) LEGISLATION.—County au. to constr. br. by act Feb. 14, 1898. PLANS.—Approv. May 31, 1898, **98,** 532.

CHOCTAWHATCHEE R., near Old Hollis Br., Ala. (Sp.) (Dale County br.) LEGISLATION.—County au. to constr. br. by act Feb. 14, 1898. PLANS.—Approv. May 31, 1898, **98,** 532.

CHOCTAWHATCHEE R., near Trawicks Landing, Ala. (Sp.) (Br. of Houston and Dale Counties.) Au. act Apr. 28, 1904. PLANS.—Approv. June 25, 1904, **04,** 712, 713.

CHOPAWAMSIC CREEK, Va. (Dr.) **07,** 815.

CHOPTANK R., Denton, Md. (S.) (Queen Anne R. R. Co.) PLANS.—Approv. Sept. 23, 1896, **97,** 532.

CHOPTANK R., Md. (S.) (Br. of Caroline and Talbot Counties—Dover Br.) PLANS.—Reconstr. approv. Mar. 19, 1910, **10,** 1030, and modified plans approv. May 27, 1910, **10,** 1030.

CHRISTIANA R., Del. (Dr.) **02,** 581.

CHRISTIANA R., on the line of the R. R. in Newcastle County, Del. (Sp., etc.) (Delaware R. R. Co.) LEGISLATION.—Company au. to constr. br. by act Sept. 19, 1890, **92,** 401. PLANS.—Reconstr. approv. Dec. 8, 1891; modified plan, increasing width of draw span 5½", and modifying the masonry constr., approv. Jan. 28, 1892. Completion of br. reported on July 5, 1892. **92,** 401.

CHRISTIANA and the **ST. JONES RS.,** Wilmington, Del. (A.) PLANS.—Reported that the draw of the Christiana Br. should be worked by steam or some mechanical power, and that turning machinery should be put in both brs. over the St. Jones R., **88,** 2538, 2660.

CHRISTIANA R., Wilmington, Del.; at Watsons Isld., Md., across the Susquehanna R.; below Pocomoke City, across the Pocomoke R., Md., and across the inland waterway from Chincoteague B., Va., to Delaware, near Lewes, Del. (A.) PLANS.—Description of the brs. and of the interference with navigation caused thereby, **88,** 2617, 2619.

CHRISTIANA R., at 3d Street, Wilmington, Del. (S.) (Newcastle County br.) PLANS.—Approv. Oct. 11, 1911, **12,** 1301, 1302.

CITY ISLD. and **PELHAM B. PARK,** chan. between, N. Y. (S.) (New York City br.) PLANS.—Reconstr. plans approv. Oct. 29, 1897, **98,** 533.

CLARK R. (See Lewis R. and.)

CLATSKANIE CREEK, Oreg. (S.) (Astoria & Columbia R. R. R. Co.) PLANS.—Approv. June 23, 1896, **96,** 426.

CLATSKANIE R., Oreg. (Dr.) **02,** 581.

CLEAR CREEK, Tex. (Sp.) (La Porte, Houston & Northern R. R. Co.) LEGISLATION.—Company au. to constr. br. by act Feb. 1, 1895. PLANS.—Approv. Mar. 25, 1895, **95,** 475.

CLEAR CREEK, between Harris and Galveston Counties, Tex. (S.) (Galveston-Houston Electric Ry. Co.) PLANS.—Approv. Jan. 14, 1910, **10,** 1026.

CLEAR CREEK, near League City, Tex. (O.) (Br. of Galveston and Harris Counties.) PLANS.—Alterations to be completed on or before June 1, 1909, **09,** 920.

CLEAR CREEK and **DICKINSON BAYOU,** Tex. (S.) (Brs. of Galveston, Harrisburg & San Antonio Ry. Co.) PLANS.—Reconstr. approv. Jan. 31, 1907, **07,** 825.

CLEARWATER R., near Kamiah, Idaho. (S.) (Clearwater Short Line Ry. Co.) PLANS.—Approv. Oct. 25, 1899, **00,** 699.

CLEARWATER R., near Kamiah, Idaho. (S.) Kamiah Br. Co., Ltd.) PLANS.—Approv. Aug. 29, 1908. Modified plans approv. Nov. 12, 1908, **09,** 916.

CLEARWATER R., LAPWAI CREEK (near mouth of), Idaho. (S.) (Clearwater Valley R. R. Co.) PLANS.—Approv. Jan. 30, 1900, **00,** 700.

CLEARWATER R., Lewiston (about 11 m. above), Idaho. (Sp.) (Spokane & Palouse Ry. Co.) LEGISLATION.—Company au. to constr. br. under act Sept. 19, 1890, and act Idaho. PLANS.—Approv. Mar. 28, 1891, **91,** 431.

CLEARWATER R., Lewiston, Idaho. (S.) (Oregon, Washington & Idaho R. R. Co.) PLANS.—Approv. Sept. 5, 1905, **06,** 802.

CLEARWATER R., Oro Tina, Idaho. (S.) (Farmers Warehouse & Br. Co.) PLANS.—Approv. Dec. 28, 1907, **08,** 871.

CLINCH R., near Dossett, Tenn. (Sp.) (Knoxville, La Follette & Jellico R. R. Co.) Au. act Feb. 3, 1903. PLANS.—Approv. Mar. 14, 1903, **03,** 644.

CLINCH R., Kingston, Tenn. (Sp.) (Roane County br.) LEGISLATION.—County au. to constr. br. by act June 9, 1897. PLANS.—Approv. June 10, 1897, **97,** 530.

CLINCH R., Kingston, Tenn. (Sp.) (Kingston Br. & Terminal Ry. Co.) Au. act Feb. 8, 1901. PLANS.—Approv. June 3, 1901, **01,** 660.

CLINCH R., at Kiser, Va. (Sp.) (Carolina, Clinchfield & Ohio Ry. Co.) Au. act May 12, 1906. PLANS.—As amended, approv. Apr. 22, 1910, and June 7, 1910, **10,** 1022.

CLINCH R., Roane County, Tenn. (S.) (Tennessee Central R. R. Co.) PLANS.—Approv. June 20, 1895, **95,** 479.

CLINCH R., near St. Paul, Va. (Sp.) (South & Western R. R. Co.) Au. act May 12, 1906. PLANS.—Approv. Dec. 4, 1906, **07,** 817.

CLINCH R. (near m. post 55.3), Scott County, Va. (Sp.) (South & Western R. R. Co.) Au. act May 12, 1906. PLANS.—Approv. Dec. 5, 1906, **07,** 818.

CLINCH R., near Starnes Bend, Scott County, Va. (Sp.) (South & Western R. R. Co.) Au. act May 12, 1906. PLANS.—Approv. Dec. 5, 1906, **07,** 818.

COAL BANK SLOUGH, Coos County, Oreg. (Sp.) (Coos B., Roseburg & Eastern R. R. & Navigation Co.) LEGISLATION.—Company au. to constr. br. by act Mar. 3, 1891. PLANS.—Approv. June 11, 1891. On Aug. 20, 1891, completion of br. reported. **91,** 432.

COAL BANK SLOUGH, Pennsylvania Avenue, Marshfield, Oreg. (S.) (Flanagan estate.) PLANS.—Approv. Sept. 12, 1907, **08,** 870.

COAL CREEK SLOUGH, near mouth of Coal Creek, Wash. (S.) (Inman-Poulsen Logging Co.) PLANS.—Approv. May 4, 1907, **07,** 827.

COHANSEY CREEK, Bridgeton, N. J. (S.) (Cumberland County br.) PLANS.—Approv. Oct. 31, 1895. Modified plans to reduce the draw opening approv. Feb. 7, 1896. **96,** 426.

COHASSET NARROWS (so-called), between Wareham and Bourne, Mass. (Sp., etc.) (Plymouth and Barnstable Counties br.) LEGISLATION.—Counties au. to constr. br. under acts Sept. 19, 1890, sec. 7, and act of Massachusetts. PLANS.—Approv. Apr. 14, 1892, **92,** 404.

COHASSET NARROWS, at Wareham and Bourne, Mass. (S.) (Old Colony R. R. Co. New York, New Haven & Hartford R. R. Co., lessee.) PLANS.—Reconstr. plans approv. Apr. 29, 1911, **11,** 1088.

COLDWATER R., near Darling, Miss. (S.) (Quitman County br.) PLANS.—Approv. Oct. 2, 1908, and modified plans Aug. 8, 1910, **09,** 915; **11,** 1082.

COLDWATER R., Marks, Miss. (Sp.) (Quitman County br.) Au. act Mar. 3, 1905. PLANS.—Approv. Apr. 26, 1906, **06,** 800.

COLDWATER R., Quitman County, Miss. (S.) (Yazoo & Mississippi Valley R. R. Co.) PLANS.—Approv. Oct. 14, 1901, **02,** 585.

COLES R., at Swansea, Mass. (S.) (Old Colony R. R. Co., New York, New Haven & Hartford R. R. Co., lessee.) PLANS.—Reconstr. plans approv. June 8, 1911, **11,** 1090.

COLORADO R., Parker, Ariz. (Sp.) (Arizona & California Ry. Co.) Au. act Feb. 6, 1908. PLANS.—Approv. Mar. 3, 1908, **08,** 867.

COLORADO R., Topock, Ariz. (Sp.) (Atchison, Topeka & Santa Fe Ry. Co.) Au. act July 21, 1866. PLANS.—For constr. of p. under the middle of the br. approv. May 12, 1910, **10,** 1022.

COLUMBIA R., Wash. (Dr.) **08,** 865.

COLUMBIA R., in Benton and Walla Walla Counties, Wash. (Sp.) (North Coast R. R. Co.) Au. act Jan. 29, 1907. PLANS.—Approv. May 13, 1909, **09,** 913.

COLUMBIA R. and U. S. CANAL, at Celilo Falls, Oreg. and Wash. (Sp.) (Oregon Trunk Ry. Co.) Au. act Mar. 2, 1910. PLANS.—Approv. Mar. 24, 1910, **10,** 1021.

COLUMBIA R., between Douglas and Kittitas Counties, Wash. (Sp.) (St. Paul, Minneapolis & Manotiba Ry. Co.) LEGISLATION.—Constr. au. by act Jan. 10, 1893. PLANS.—Submitted Sept. 30, 1892; approv. Feb. 14, 1893, **93,** 464.

COLUMBIA R., between Douglas and Kittitas Counties, Wash. (Sp.) (Chicago, Milwaukee & St. Paul Ry. Co.) Au. act Apr. 9, 1906. PLANS.—Approv. Oct. 27, 1906, **07,** 817.

COLUMBIA R., Northport, Wash. (Sp.) (Columbia & Red Mountain Ry. Co.) LEGISLATION.—Company au. to constr. br. by act Jan. 27, 1897. PLANS.—Approv. Sept. 30, 1897, **98,** 531.

COLUMBIA R., near Vancouver, Wash. (Sp.) (Oregon Ry. Extensions Co.) LEGISLATION.—Company au. to constr. br. by act Aug. 29, 1890. PLANS.—Approv. Sept. 29, 1890, **91,** 429.

COLUMBIA R., Wenatchee, Wash. (Sp.) (Washington Br. Co.) Au. act Jan. 20, 1906. PLANS.—Approv. Apr. 13, 1906, **06,** 799.

COLUMBIA R., COLUMBIA and OREGON SLOUGHS, Oreg. (S.) (Portland, Vancouver & St. Johns R. R. Co.) PLANS.—Approv. Oct. 19, 1905, **06,** 802.

COLUMBIA R. and OREGON SLOUGH (of Columbia R.), Vancouver, Wash. (Sp.) (Portland & Seattle Ry. Co.) Au. act Dec. 21, 1905. PLANS.—Approv. Feb. 12, 1906, **06,** 799; and slightly modified Nov. 19, 1906, **07,** 817, 824.

COLUMBIA SLOUGH, Multnomah County Oreg. (S.) (Oregon & Washington R. R. Co.) PLANS.—Approv. Dec. 23, 1908, **09,** 916.

COMMENCEMENT B., Tacoma, Wash. (O.) (Northern Pacific R. R. Co.) PLANS.—Specified alterations to R. R. br. required on or before Mar. 1, 1893, **92,** 412.

COMPANY CANAL, La. (Dr.) **08,** 865.

CONDADO B., San Juan, P. R. (Sp.) (Behn Bros.) Au. act Feb. 25, 1909. PLANS.—Approv. Apr. 29, 1909, **09,** 913; and Oct. 21, 1909, **10,** 1020.

CONECUH R., Henleys Ferry, near Brewerton, and at Parkers Ferry, Ala. (Sp.) (Escambia County brs.) LEGISLATION.—County au. to constr. brs. by act Mar. 2, 1899. PLANS.—Approv. Sept. 19, 1899, **00,** 697.

CONECUH R., near Pollard, Ala. (Sp.) (Lindsey Lumber Co.) Au. act Jan. 27, 1905. PLANS.—Approv. May 15, 1905, **05,** 722.

CONEY ISLD. CREEK, from W. 17th Street to W. 18th Street, N. Y. (S.) (Brooklyn city br.) PLANS.—Approv. May 28, 1897, **97,** 534.

CONEY ISLD. CREEK, N. Y. (A.) (Brooklyn Heights R. R. Co., West End Br.) PLANS.—Reconstr. in accordance with requirements approv. Dec. 20, 1901. Alterations to be completed on or before Apr. 1, 1903. **02,** 590.

CONEY ISLD. CREEK, Coney Isld., N. Y. (S.) (Brs. of Brooklyn Rapid Transit Co.) PLANS.—Reconstr. 2 brs. approv. Oct. 13, 1906, **07,** 822.

CONGAREE R., near Columbia, S. C. (S.) (South Bound R. R. Co.) PLANS.—Approv. Aug. 4, 1899, **99,** 623.

CONNEAUT CREEK, at Conneaut, Ohio. (S.) (Pittsburgh, Bessemer & Lake Erie R. R. Co.) PLANS.—Br. to replace existing str. approv. Apr. 1, 1910, **10,** 1029.

CONNECTICUT R. (See Coscob, etc.)

CONNECTICUT R., between E. Haddam and Haddam, Conn. (Sp.) (State br.) Au. act Jan. 25, 1912. PLANS.—Approv. Mar. 4, 1912, **12,** 1297.

CONNECTICUT R., between Hartford and E. Hartford, Conn. (A. and O.) (State br.) PLANS.—Alteration plans approv. Dec. 28, 1894, **95,** 480. Draw with span 100′ in clearance, at the third span from Hartford shore, to be completed on or before Oct. 1, 1895, **95,** 483.

CONNECTICUT R., at Hartford, Conn. (Sp.) (Connecticut R. Br. and Highway District.) Au. act Feb. 18, 1903. PLANS.—Approv. May 21, 1903, **03,** 644.

CONNECTICUT R., Middletown, Conn. (O.) (New York, New Haven & Hartford R. R. Co.) PLANS.—Specified alterations to be completed within 2 months from July 2, 1896, **96,** 429. Reconstr. approv. Sept. 16, 1910, **11,** 1083.

CONNECTICUT R., between Middletown and Portland, Conn. (S.) (Middletown & Portland Br. Co.) PLANS.—Approv. Aug. 6, 1895; modified plans approv. Aug. 28, 1895, **95,** 480.

CONNECTICUT R., at Old Saybrook and Old Lyme, Conn. (Sp.) (New York, New Haven & Hartford R. R. Co.) Au. act Apr. 7, 1904. PLANS.—Approv. Mar. 29, 1905, **05,** 721.

CONNECTICUT R., between Old Saybrook and Old Lyme, Conn. (Sp.) (Saybrook & Lyme, Connecticut Br. Commission.) Au. act Feb. 28, 1910. PLANS.—Approv. Mar. 15, 1910, **10,** 1021.

CONNECTICUT R., between Springfield and Agawam, Mass. (O.) (South End Br.) PLANS.—Alterations to be completed within 6 months from Sept. 15 and 16, 1902, **03,** 652.

CONNECTICUT R., Chicopee and W. Springfield, Mass. (Sp.) (Hampden County br.) Au. act Apr. 28, 1904. PLANS.—Constr. approv. Oct. 29, 1904; approval subsequently modified by instrument dated Aug. 3, 1905, **05,** 720; **06,** 799.

CONTENTNIA CREEK, near Grifton, N. C. (Sp.) (Wilmington & Weldon R. R. Co.) LEGISLATION.—Company au. to constr. br. by act Aug. 23, 1894. PLANS.—Approv. Aug. 29, 1894, **94,** 426.

CONTENTNIA CREEK, Hookertown, N. C. (S.) (East Carolina Ry.) PLANS.—Approv. May 11, 1907, **07,** 827.

COOPER CREEK, Baird Avenue, Camden, N. J. (S.) (Camden County br.) PLANS.—Approv. Mar. 26, 1902, **02,** 587.

COOPER CREEK, Browning Road, Camden, N. J. (S.) (Camden County br.) PLANS.—For rebuilding approv. Aug. 17, 1900, **01,** 662.

COOPER CREEK, Federal Street, Camden, N. J. (O.) (City & Camden Horse R. R. Co.) PLANS.—Specified alterations required of city and R. R. company on or before Sept. 30, 1892, **92,** 412.

COOPER CREEK, Federal Street, Camden County, N. J. (S.) (Camden County br.) PLANS.—Approv. Dec. 29, 1905, **06,** 803.

COOPER CREEK, State Street, Camden, N. J. (S.) (Camden County br.) PLANS.—Reconstr. plans approv. June 16, 1898, **98,** 536.

COOPER CREEK, Stoys Landing, N. J. (S.) (Camden County br.) PLANS.—Approv. Aug. 11, 1903, **04,** 714.

COOSA R., Ga. and Ala. (A.) (Central R. R. of Georgia; Talladega & Coosa Valley R. R.; East & West R. R.; Georgia Pacific R. R.; and Annison & Cincinnati R. R.—5 brs.) PLANS.—3 of the brs. too low and have no draw; one has a draw that will not work, **89,** 2797.

COOSA R., Gadsden, Ala. (Sp.) (Louisville & Nashville R. R. Co.) PLANS.—Reconstr. approv. June 16, 1909, **09,** 914.

COOSA R., near Lock No. 3, Ala. (O.) (Seaboard Air Line Ry. Co.) PLANS.—Alterations to be completed on or before Dec. 1, 1906, **06,** 809.

COOSAW R., WHALE BRANCH, Port Royal Ferry, S. C. (S.) (Beaufort County br.) PLANS.—Approv. Apr. 21, 1908, **08,** 872.

COOSAWATTEE R., Ga. (See Oostenaula R. and —.)

COOSAWATTEE R., Carters, Ga. (S.) (Louisville & Nashville R. R. Co.) PLANS.—Approv. Mar. 30, 1905, **05,** 726.

COOSAWATTEE R., near Fields Ferry, Ga. (S.) (Gordon County br.) PLANS.—Approv. Mar. 3, 1908, **08,** 872.

COPPER R., near Childs Glacier, Alaska. (Sp.) (Alaska Pacific Ry. & Terminal Co.) Au. act June 30, 1906. PLANS.—Approv. Nov. 16, 1907, **08,** 867.

COPPER R., near mouth of Chitina R., Alaska. (Sp.) (Copper R. & Northwestern Ry. Co.) Au. act Mar. 26, 1910. PLANS.—Constr. of a permanent and a temporary br. approv. Aug. 16, 1910, **11,** 1079.

CORDELIA SLOUGH, Cal. (See Pacheco Slough.)

CORNEY BAYOU, near Cobb Landing, La. (S.) (Summit Lumber Co.) PLANS.—Temporary br. approv. July 8, 1911, **12,** 1299.

CORPUS CHRISTI CHAN. (Morris and Cummings Ship Chan.), Tex. (Sp.) (Arkansas H. Terminal Ry. Co.) LEGISLATION.—Company au. to constr. br. by act May 4, 1896. PLANS.—Approv. Apr. 21, 1897, **97,** 530.

CORTE MADERA CREEK, Cal. (S.) (Bay Counties Ry. Co.) PLANS.—Approv. Mar. 5, 1906, **06,** 804.

COSCOB, CONN.; Bridgeport, Conn.; Housatonic R., Conn.; New Haven, on the Quinnipiac R., Conn.; Middletown, on the Connecticut R., Conn.; the city brs. at Bridgeport; the city and the Tomlinson brs. at New Haven, Conn. (A.) (New York, New Haven & Hartford R. R. Co.) COMMERCE.—Protests of C. interests against brs. 2, 4, 5, 7, and 8, **88,** 2535, 2537. PLANS.—Lt. Col. McFarland proposed to widen the clear way at brs. 3 and 5 by removal of certain underwater portions of the ps.; to require the introduction of draws at brs. 4 and 7, and the widening of the draw at br. 8, and to secure, with steam power, a more expeditious opening and closing of the draws at brs. 1 and 2, **88,** 2532, 2534.

COSCOB R., Greenwich, Conn. (S.) (New York, New Haven & Hartford R. R. Co.) PLANS.—Rebuilding existing br. and constr. of temporary trestle approv. Dec. 2, 1903, **04,** 715.

COURTABLEAU BAYOU, near Port Barre, La. (S.) (Opelousas, Gulf & Northeastern Ry. Co.) PLANS.—Approv. Feb. 27, 1906, **06,** 804.

COURTABLEAU BAYOU, Port Barre, La. (S.) (St. Landry Parish br.) PLANS.—Reconstr. approv. July 23, 1907, **08,** 868.

COURTABLEAU BAYOU, St. Landry Parish, La. (S.) (Colorado Southern, New Orleans & Pacific R. R. Co.) PLANS.—Approv. May 25, 1906, **06,** 807. Modified plans approv. Feb. 2, 1907, **07,** 825.

COW BAYOU, about 6 m. above its confluence with Sabine R., Tex. (S.) (Orange County br.) PLANS.—Approv. July 6, 1893, **93,** 470. New plans approv. Oct. 6, 1893, **94,** 426.

COWLITZ R., Wash. (Dr.) **10,** 1019.

COWLITZ R., Castlerock, Wash. (S.) (Br. of D. M. Eddy.) PLANS.—Approv. Feb. 6, 1903, **03,** 648.

COWLITZ R., Castlerock, Wash. (S.) (Cowlitz County br.) PLANS.—Br. to replace str. carried away, approv. Jan. 20, 1910; and modified plans approv. June 6, 1910, **10,** 1030.

COWLITZ R., at Kelso and Catlin, Wash. (S.) (Kelso Br. Co.) PLANS.—Approv. Dec. 20, 1904, **05,** 725.

COWLITZ R., Olequa, Wash. (S.) (Northern Pacific Ry. Co.) PLANS.—Rebuilding approv. Sept. 30, 1907, **08,** 870; and Aug. 9, 1910, **11,** 1082.

COWLITZ R., near Olequa, Wash. (S.) (Oregon & Washington R. R. Co.) PLANS.—Approv. May 3, 1907, **07,** 827.

COWLITZ R., Toledo, Wash. (Sp., etc.) (Lewis County br.) LEGISLATION.—County au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Washington. PLANS.—Approv. Nov. 19, 1891, **92,** 401.

COYOTE CREEK, Cal. (See Warm Spring and Coyote Creeks.)

CRAVEN THOROUGHFARE, N. J. (See Leonards Thoroughfare.)

CROOK HORN THOROUGHFARE, N. J. (S.) (Atlantic City R. R. Co.) PLANS.—To replace existing br. approv. Feb. 14, 1910 **10,** 1027.

CRUM CREEK, Delaware County, Pa. (S.) (See Darby Creek, Pa.) (Baltimore & Philadelphia R. R. Co.) PLANS.—Approv. Dec. 2, 1909, **10,** 1025.

CRYSTAL COVE, Winthrop, Mass. (S.) (Boston, Revere Beach & Lynn R. R. Co.) PLANS.—Reconstr. approv. Nov. 8, 1901, **02,** 586.

CUMBERLAND R. (See Ohio R.)

CUMBERLAND R., Carthage, Tenn. (Sp.) (Town br.) Au. act Mar. 2, 1901, Mar. 2, 1903, and Apr. 27, 1904. PLANS.—Approv. Mar. 4, 1904, **04,** 711.

CUMBERLAND R., Clarksville, Tenn. (S.) (Louisville & Nashville R. R. Co.) PLANS.—For floating cribs between center p. and rest ps. of draw span; approv. June 16, 1898, **98,** 536.

CUMBERLAND R., Davidson County, Tenn. (Sp.) (Nashville Terminal Co.) Au. act June 18, 1902. PLANS.—Approv. Aug. 18, 1902, **03,** 643.

CUMBERLAND R., Tenn. and Ky. (Dr.) **08,** 865.

CUMBERLAND R., between Maplewood and Overtons, near Nashville, Tenn. (Sp.) (Lewisburg & Northern Ry. Co.) Au. act Feb. 9, 1912. PLANS.—Approv. Mar. 20, 1912, **12,** 1298.

CUMBERLAND R., Nashville, Tenn. (Sp.) (Wagon br.) LEGISLATION.—Au. act Mar. 3, 1887, **88**, 308, 2438. PLANS.—Description of proposed br., **88**, 2440. Modification made and approv., **88**, 2441. Lt. Col. Barlow did not consider that the br. as proposed would form any obstr. to navigation, **88**, 2441.

CUMBERLAND R., Sparkman and Jefferson Streets, Nashville, Tenn. (Sp.) (Davidson County brs.) Au. act Apr. 24, 1906, and Feb. 25, 1907. PLANS.—Approv. May 8, 1907, **07**, 819.

CUMBERLAND R., S. Fork, near Burnside, Ky. (S.) (Pulaski County br.) PLANS.—Approv. Aug. 19, 1903, **04**, 714.

CUMBERLAND R., S. Fork, near Burnside, Ky. (S.) (Cumberland R. & Nashville R. R. Co.) PLANS.—Approv. May 17, 1906, **06**, 807. Modified plans in lieu thereof approv. Oct. 3, 1907, **08**, 870.

CUMBERLAND R., S. Fork, at Yamacraw, Ky. (S.) (Kentucky & Tennessee Ry. Co.) PLANS.—Approv. Mar. 12, 1906, **06**, 804, 805.

CURRENT R., Ark. (Sp.) (Southern Missouri & Arkansas R. R. Co.) Au. act Feb. 11, 1902. PLANS.—Approv. Feb. 28, 1902, **02**, 582.

CURRENT R., near Van Buren Ferry, Mo. (Sp.) (Carter County br.) Au. act Feb. 1, 1909. PLANS.—Approv. Apr. 8, 1909, **09**, 913.

CURRY CREEK (Roberts B.), Fla. (See Shakit or Salt Creek.)

CUYAHOGA R., Cleveland, Ohio. (S.) (Cleveland, Cincinnati, Chicago & St. Louis Ry. Co.) PLANS.—Reconstr. plan approv. Jan. 30, 1899, **99**, 622.

CUYAHOGA R., Cleveland, Ohio. (S.) (Cincinnati, Chicago & St. Louis Ry. Co.) PLANS.—Rebuilding approv. Sept. 20, 1900, **01**, 663.

CUYAHOGA R., Cleveland, Ohio (S.) (Newburg & South Shore Ry. Co.) PLANS.—Two brs. approv. June 25, 1903, **03**, 650.

CUYAHOGA R., Cleveland, Ohio. (A.) (Wheeling & Lake Erie R. R. Co.) PLANS.—Reconstr. approv. Oct. 25, 1904, **05**, 728.

CUYAHOGA R. (old bed of), Cleveland, Ohio. (O.) (Cleveland Terminal & Valley R. R. Co. of the Baltimore & Ohio system.) PLANS.—Rebuilding approv. Jan. 25, 1905, **05**, 725. Alterations to be completed on or before Apr. 1, 1906, **05**, 729. Approv. Jan. 28, 1909, **09**, 917.

CUYAHOGA R., Cleveland, Ohio. (S.) (New York, Chicago & St. Louis R. R. Co.) PLANS.—Rebuilding approv. May 17, 1906, **06**, 807.

CUYAHOGA R., Jefferson Street, Cleveland, Ohio. (S.) (City brs.) PLANS.—Imp. of R., involving reconstr. of br. and erection of new br., approv. Dec. 16, 1902, **03**, 647.

CUYAHOGA R., near Jefferson Street, Cleveland, Ohio. (S.) (Cleveland & Mahoning Valley R. R. Co., and the Erie R. R. Co.) PLANS.—Approv. Feb. 16, 1910, **10**, 1027.

CUYAHOGA R., Middle Seneca Street, Cleveland, Ohio. (S.) (City br.) PLANS.—Rebuilding approv. Dec. 4, 1901, **02**, 586.

CUYAHOGA R., Cleveland, Ohio. (S.) (Brs. of Wheeling & Lake Erie R. R. Co.) PLANS.—Reconstr. of 2 existing brs. approv. Jan. 29, 1912, **12**, 1305. Modified plans approv. June 10, 1912, and instrument dated Jan. 29, 1912, canceled, **12**, 1308.

CUYAHOGA R., Cleveland, Ohio. (S.) (City br., known as Central Avenue Viaduct.) PLANS.—Reconstr. approv. Apr. 24, 1906, **06**, 806; instrument canceled Aug. 4, 1910. New plans approv. May 5, 1911, **11**, 1088, 1089.

CUYAHOGA R., Detroit-Superior Avenue, Cleveland, Ohio. (S.) (Cuyahoga County br.) PLANS.—Approv. Jan. 11, 1912, **12**, 1304.

CYPRESS CREEK, Va. (See Elizabeth R.)

D.

DAMARISCOTTA LAKE (outlet of), between Newcastle and Nobleboro, Me. (S.) (Maine Central R. R. Co.) PLANS.—Rebuilding approv. June 27, 1904, **04**, 719.

DANVERS (Bass) **R.**, at Salem and Beverly, Mass. (S.) (Essex County br.) PLANS.—Approv. June 2, 1906, **06**, 807.

D'ARBONNE BAYOU, La. (S.) (Kinder & North Western R. R. Co.) PLANS.—Approv. June 9, 1910, **10**, 1030.

D'ARBONNE BAYOU, Cox Ferry, La. (S.) (Union Parish br.) PLANS.—Approv. Aug. 10, 1906, **07**, 821.

DARBY CREEK, Media, Pa. (See Schuylkill R.) (S.) (Delaware County br.) PLANS.—Approv. Jan. 31, 1907, **07**, 825.

DARBY CREEK and **CRUM CREEKS**, Delaware County, Pa. (S.) (Philadelphia & Chester Ry. Co.) PLANS.—Approv. Dec. 11, 1900, **01**, 663.

DARIEN R., Ga. (See Altamaha R.)

DAVIS SLOUGH, Puget Sound, near Stanwood, Wash. (Snohomish County br.) PLANS.—Reconstr. approv. Mar. 9, 1912, **12**, 1305.

DAY ISLD. WATERWAY, near Tacoma, Wash. (S.) (Day Isld. Co.) PLANS.—Approv. July 15, 1908, **09**, 914.

DEAD R., Fla. (Dr.) **04**, 710.

DEAD R., between Leesburg and Fruitland Park, Fla. (O.) (Lake County br.) PLANS.—Alterations to be completed on or before Oct. 1, 1906, **06**, 809.

DECEPTION and **CANOE PASSES** connecting Whidbey Pass and Fidalgo Islds., Wash. (S.) (Brs. of Highway Commission of Washington.) PLANS.—Approv. Jan. 9, 1909, **09**, 916.

DECKERS COVE, Southport, Me. (S.) (Town br.) PLANS.—Approv. May 10, 1907, **07**, 827.

DEEP R., Wahkiakum County, Wash. (S.) (County br.) PLANS.—Approv. Oct. 11, 1899, **00**, 699.

DELAWARE B. (See Chincoteague B. and —.)

DELAWARE R., near Columbia, N. J., and Slateford, Pa. (Sp.) (Delaware, Lackawanna & Western R. R. Co.) Au. act Jan. 14, 1909. PLANS.—Approv. Mar. 9, 1909, **09**, 913.

DELAWARE R., Philadelphia, Pa. (Sp.) (Pennsylvania and New Jersey R. R. Co. of N. J.) LEGISLATION.—Company au. to constr. br. by act June 14, 1894. PLANS.—Submitted Aug. 30, 1894; modified Oct. 11, 1894; approv. Nov. 3, 1894, **95**, 474.

DELAWARE R., between Philadelphia and Camden. (Sp.) BE. Convened at Philadelphia May 10, 1870. Proceedings, **71**, 709. Reconvened Oct. 15, 1870. **R.**, **71**, 710, 713, 718. Reconvened at Philadelphia, Dec. 7, 1870, and Apr. 29, 1871, **71**, 713, 718. (Lt. Cols. Woodruff and Kurtz, and Capt. King.) LEGISLATION.—Br. au. by act Apr. 6, 1870; requirements of act, **71**, 81. PLANS.—Of Philadelphia & Camden Br. Co. described, **71**, 710. Comments of board, **71**, 710, 711, 718. Approv. by Sec. of War, **71**, 718.

DELAWARE R., Trenton, N. J. (Sp.) (Pennsylvania R. R. Co.) Au. act Feb. 15, 1901. PLANS.—Approv. June 14, 1901, **01**, 661.

DELAWARE R., Yardley, Pa. (Sp.) (Philadelphia & Reading Ry. Co.) Au. act Feb. 27, 1911. PLANS.—Br. to replace existing str. approv. Apr. 24, 1911, **11**, 1081.

DES ALLEMANDS BAYOU, La. (O. and A.) (Southern Pacific Ry., Morgan's Louisiana & Texas R. R. & S. S. Co.) PLANS.—Reconstr. approv. July 24, 1903, **04**, 720.

DES ALLEMANDS BAYOU, Lafayette and St. Charles Parishes, La. (S.) (Morgan's Louisiana & Texas R. R. & S. S. Co.) PLANS.—Reconstr. approv. Sept. 10, 1907, **08**, 870.

DESCHUTES R., Olympia, Wash. (S.) (Northern Pacific Ry. Co.) PLANS.—Rebuilding approv. July 16, 1902, **03**, 645.

DESCHUTES R., Olympia, Wash. (S.) (City br.) PLANS.—Approv. May 7, 1904, **04**, 718.

DES GLAISES BAYOU, La. (Sp.) (St. Louis, Avoyelles & Southwestern R. R. Co.) LEGISLATION.—Company au. to constr. br. by act Aug. 23, 1894. PLANS.—Approv. Oct. 26, 1895; modified plans submitted Dec. 22, 1895, providing for a wooden drawspan in lieu of one of iron required by approv. plans; approv. Jan. 15, 1896, **96**, 423.

DES GLAISES BAYOU, Avoyelles Parish, La. (S.) (Shreveport & Red R. Valley Ry. Co. brs.) PLANS.—Approv. Jan. 23, 1903, **03**, 648.

DES GLAISES BAYOU, Iberville Parish, La. (S.) (Morgan's Louisiana & Texas R. R. & S. S. Co.) PLANS.—Approv. May 25, 1906, **06**, 807.

DES GLAISES BAYOU, near Moreauville, La. (S.) (Avoyelles Parish br.) PLANS.—Approv. Aug. 3, 1903, **04**, 713.

DES MOINES RAPIDS CANAL, Ill. (See Mississippi R.)

DES OURSE BAYOU, St. Martin Parish, La. (S.) (Morgan's Louisiana & Texas R. R. &

S. S. Co.) PLANS.—Approv. Aug. 17, 1906, **07**, 821.

DETROIT, MICH., chan. between Lakes Huron and Erie—across the. COMMERCE.—Waterway fully described, **74**, 588. Tables of t. on the lakes and elsewhere, **74**, 590, et seq.; **74**, 619, R. R. ferry crossing, **74**, 594, et seq.; **74**, 634. High and low brs. discussed, **74**, 630. History of proposed tunnel, **74**, 598, 608, 619, 631. Rates on freight, **74**, 599. Freights, etc., Michigan Central R. R. Co., **74**, 600. Statements of various parties for and against proposed br., **74**, 613, 620-631, 633-636. R. R. interests presented by J. F. Joy, president Michigan Central R. R. Co., **74**, 604. Memorial to Congress for double-track R. R., Chicago to New York, **74**, 610. Memorial to Legislature of Michigan against bridging Detroit R., **74**, 617. Proposals of R. R. companies, **74**, 630. Statistics, **74**, 611; **80**, 1857, 1862. Chief of Engineers. **R.**, **74**, 71; **80**, 199. BE. convened at Detroit, Mich., May 12, 1873, and heard opinions of the opposing interests. Reconvened Nov. 14; reported against a drawbr. and favorably to high br. or tunnel. Conclusions of the board. **74**, 603. **R.**, **74**, 587. (Majs. Warren, Comstock, Weitzel, and Merrill, and Capt. Livermore.) Convened at Detroit Oct. 14, 1879, **80**, 1853. Tunnel under the R. the most satisfactory solution. If br. be built, it should be provided with a draw span of not less than 300′. Fixed spans not less than 450′ in the clear, with 60′ headway. **80**, 1855. Maj. Wilson did not concur in plan of br. with draw, **80**, 1856. (Lt. Cols. Raynolds and Michler, and Majs. Poe, Houston, and Wilson.) PLANS.—Of brs. described and discussed by BE., **74**, 600. By br. company. (1) Low br. with 2 draws; est., $2,457,550, **74**, 628. (2) For br. 150′ above ordinary water surface; est., $8,947,000, **74**, 628. (3) For winter br. with 1 draw and 2 movable spans of 400′ each, to be removed during the season of navigation: est., $1,966,500, **74**, 629. Described and discussed by BE., **80**, 1854.

DETROIT R. (Belle Isle and the American shore.) COMMERCE.—Conservation of navigable waters by the U. S., **85**, 292, 1918.

DETROIT R., across the. (Detroit, Mich.) **90**, 3456. COMMERCE.—Shipping interests, **90**, 3457. BE. convened at Detroit, Mich., July 19, 1889, by S. O. No. 15, to report upon the practicability and necessity of a br. over Detroit R. at Detroit. Board reported the constr. of such a br. feasible, and, of the projs. submitted to them, recom. that for a high br. **R.**, **90**, 3456, 3463. (Col. Poe and Majs. Allen and Adams.)

DETROIT R. (w. chan.). (Sp.) (Belle Isle Park and the mainland.) **88**, 308; **97**, 529. LEGISLATION.—Br. au. act July 20, 1886, **88**, 2456. PLANS.—Proposed location and dimensions of br. and approaches, **88**, 2452. Lt. Col. Poe approv. location and constr. of br. as designed, **88**, 2451. Reconstr. plans approv. Apr. 8, 1897 **97**, 529.

DETROIT R., between Groose Isle and Stony Isld., Mich. (O.) (Michigan Central R. R. Co.) PLANS.—Alterations to be completed on or before May 1, 1905, **05**, 729.

DETROIT R. (w. chan.) to Grosse Isle, near city of Wyandotte, Mich. (S.) (Grosse Isle Ry. Co.) PLANS.—Reconstr. approv. June 11, 1912, and instrument of approval issued to P. N. Jacobson, dated Mar. 12, 1910, canceled, **12**, 1308.

DETROIT R., from Wyandotte to the isld. of Grosse Isle, Mich. (S.) (P. N. Jacobson.) PLANS.—Approv. Mar. 12, 1910, **10**, 1028.

DICKINSON BAYOU, Tex. (See Clear Creek.) (O.) Galveston, Houston & Henderson R. R. Co.) PLANS.—Specified alterations required on or before May 20, 1893, **93**, 473.

DICKINSON BAYOU, Tex., about ½ m. above its mouth. (S.) (North Galveston, Houston & Kansas City R. R.) PLANS.—Approv. Oct. 13, 1892, **93**, 466.

DICKINSON BAYOU, Galveston County, Tex. (S.) (Galveston-Houston Electric Ry. Co.) PLANS.—Approv. Jan. 14, 1910, **10**, 1026.

DIVIDING CREEK, at town of Dividing Creek, N. J. (O.) (Cumberland County br.) PLANS.—Specified alterations to be completed within 10 months from Feb. 19, 1902, **02**, 591.

DOG R., Ala. (S.) (Mobile West Shore Traction Co.) PLANS.—Approv. Dec. 13, 1911, **12**, 1303.

DOG R., Mobile, Ala. (S.) (Dauphin Island Ry. & Harbor Co.) PLANS.—Approv. Dec. 12, 1911, **12**, 1303.

DOG R., Mobile County, Ala. (S.) (Rudolph Benz br.) PLANS.—Approv. Feb. 20, 1901, **01**, 665.

DOG R., Jackson County, Miss. (Sp.) (W. Denny & Co.) Au. act Apr. 11, 1904. PLANS.—Approv. Apr. 22, 1904, **04**, 712.

DOG AND FOWL RS., Ala. (S.) (Mobile & Dauphin Island R. R. & Harbor Co.) PLANS.—Approv. Nov. 3, 1893, **94**, 426.

DOODLETOWN BIGHT, or **CREEK**, N. Y. (S.) (New York Central & Hudson R. R. R. Co.) PLANS.—Reconstr. approv. Dec. 13, 1906 **07**, 824.

DUCK CREEK, near Duck Creek, Wis. (S.) (Chicago & North Western Ry. Co.) PLANS.—Br. to replace existing str. approv. Nov. 21, 1903, **04**, 715.

DUCK R., Cold Branch Ferry, Tenn. (S.) (Humphreys County br.) PLANS.—Approv. Sept. 12, 1895, **96**, 424.

DUCK R., above the mouth of Buffalo R., near Link Ford, Tenn. (S.) (Humphreys County br.) PLANS.—Approv. Feb. 25, 1910, **10**, 1027

DUCK R., Lyme, Conn. (S.) (New York, New Haven & Hartford R. R. Co.) PLANS.—Reconstr. approv. Nov. 8, 1906, **07**, 823.

DULUTH CANAL, Duluth, Minn. (Sp.) (City br.) Au. act Feb. 7, 1902. PLANS.—Approv. Sept. 14, 1903, **04**, 711.

DULUTH H., canal at, at entrance, Duluth, Minn. (S.) (City br.) BE. constituted by S. O. No. 6, Feb. 1, 1892, to ex. and R. upon the plans of a br. over the entrance to Duluth H., on Lake Avenue, submitted by the board of public works of the city of Duluth, Minn. R., **92,** 3315. (Col. O. M. Poe, Majs. W. Ludlow and W. A. Jones.) LEGISLATION.—City au. to constr. br. by Minnesota. PLANS.—For a lift br., referred to BE.; public hearing given interested parties; Chief of Engineers concurred in recom. of BE. and the plans disapprov. Apr. 11, 1892, **92,** 410.

DULUTH-SUPERIOR, MINN. and **WIS.** (Dr.) **10,** 1019.

DUNNS CREEK, Putnam County, Fla. (S.) (County br.) PLANS.—Approv. Mar. 10, 1910, **10,** 1028.

DURHAMS CREEK, Bonnerton, N. C. (O.) (Beaufort County br.) PLANS.—Alterations to be completed on or before Feb. 1, 1905, **05,** 730.

DUTCH KILLS CREEK, Borden Avenue, New York, N. Y. (S.) (City br.) PLANS.—Br. to replace existing str. approv. Mar. 12, 1902, **02,** 587. Plans in lieu thereof, and for a temporary br., approv. Oct. 19, 1905, **06,** 803.

DUTCH KILLS CREEK, Long Island City, N. Y. (S.) (Long Island R. R. Co.) PLANS.—Reconstr. plans approv. Mar. 27, 1893, **93,** 469.

DUWAMISH R., Kings County, Wash. (S.) (County br.) PLANS.—Approv. Mar. 29, 1900, **00,** 700. Approv. Oct. 11, 1900, in lieu of plans approv. Mar. 29, 1900, **01,** 663. Approv. Sept. 23, 1901, **02,** 585.

DUWAMISH R., sec. 29, T. 24 N., R. 4 E., Wash. (Sp., etc.) (Valley Street Ry. Co.) LEGISLATION.—Company au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Washington. PLANS.—Approv. Oct. 17, 1891; completed Mar. 4, 1892, **92,** 400.

DUWAMISH R., Bateman Street, Georgetown, Wash. (S.) (King County br.) PLANS.—Approv. Apr. 23, 1906, **06,** 806.

DUWAMISH R., King County, Wash. (S.) (Seattle-Tacoma Interurban Ry.) PLANS.—Approv. Aug. 13, 1901, **02,** 584.

DUWAMISH R., near Seattle, Wash. (Sp.) (Northern Pacific & Puget Sound Shore R. R. Co.) LEGISLATION.—Company au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Washington. PLANS.—Approv. Mar. 6, 1891, **91,** 431.

DUWAMISH R., Seattle, Wash. (S.) (City br.) PLANS.—Approv. Dec. 6, 1909, **10,** 1025.

DUWAMISH R., near Seattle, Wash. (S.) (Seattle Electric Co.) PLANS.—Approv. Sept. 6, 1901, **02,** 584, 585.

DUWAMISH R., near Seattle, Wash. (S.) (Northern Pacific Ry. Co.) PLANS.—Approv. Mar. 25, 1904, **04,** 717.

DUWAMISH R., waterways at entrance, Seattle, Wash. (O.) (Seattle Electric Co.) PLANS.—Alterations to be completed on or before Oct. 31, 1909, **09,** 920.

DUWAMISH R., W. waterway, Seattle, Wash. (O.) (City br.) PLANS.—Alterations to be completed on or before Oct. 31, 1909, **09,** 920.

DUWAMISH R., W. waterway, Seattle, Wash. (O.) (Northern Pacific Ry. Co.) PLANS.—Alterations to be completed on or before Oct. 31, 1909, **09,** 920.

E.

EAST CHESTER B., in Pelham B. Park, N. Y. (See Hutchinson R.) (S.) (New York City br.) PLANS.—Br. to replace existing str. approv. May 18, 1903, **03,** 650.

EAST HAVEN R., Conn. (O.) (Br. of towns of Branford and East Haven, Conn., the Tide Water Traprock Co., and the Stony R. Dike Co.) PLANS.—Alterations to be completed on or before the expiration of 3 months from Feb. 2, 1904, **04,** 721.

EAST MACHIAS R., E. Machias, Me. (S.) (Washington County Ry. Co.) PLANS.—Approv. July 10, 1905, **06,** 800.

EAST PASCAGOULA R., near Scranton, Miss. (S.) (Louisville & Nashville R. R. Co.) PLANS.—Rebuilding approv. Mar. 30, 1904, **04,** 717.

EAST PEARL R., Miss. (Dr.) **08,** 865.

EAST R., at Hell Gate, and over Little Hell Gate and Bronx (or Harlem) Kills, near Astoria, N. Y. (Sp.) (Brs. of New York Connecting R. R. Co.) PLANS.—Constr. of these brs. approv. Jan. 16 and Mar. 2, 1901, **01,** 664. Plans in lieu thereof approv. June 22, 1906, **06,** 800. Approv. Apr. 4, 1912, for modification of 3 brs. in lieu of plans approv. June 22, 1906, **12,** 1307.

EAST R., 60th Street, Manhattan to Long Island City, via Blackwells Isld., N. Y. (S.) (City br.) PLANS.—Approv. Feb. 21, 1901, **01,** 665.

EAST R., between New York City and Long Isld. (Sp.) (New York & Long Island Br. Co.) **88,** 309. LEGISLATION.—Br. au. by act Mar. 3, 1887, **88,** 2471. PLANS.—Plan and location of proposed br. approv. by Sec. of War, **88,** 2472.

EAST R. (br. No. 3), New York, N. Y. (S.) (City br.) PLANS.—Approv. Jan. 29, 1900, **00,** 700. Modified plans in lieu of orig. plans were approv. Jan. 5, 1905, **05,** 725.

EAST R., between New York and Brooklyn. (Sp.) (New York Br. Co.) **69,** 56, 395. BE. constituted by S. O. No. 72, convened at New York, May 22, 1869, to ex. and **R.** upon the proposed br. between New York and Brooklyn. **R., 69,** 397. (Lt. Cols. H. G. Wright and J. Newton, and Maj. W. R. King.) LEGISLATION.—Company au. to constr. br. by act Mar. 3, 1869, **69,** 404. PLANS.—Approv. June 19, 1869. Height of center span to be 135′ clear, m. l. w., **69,** 405.

EAST R., between New York and Brooklyn, N. Y. (S.) (East River Br. Co., one above and one below the navy yard.) **93,** 467; **97,** 532. PLANS.—Submitted Oct. 15, 1892, provided for a clearance of 135′ at the center of the spans and 120′ at the ps. above m. h. w.; BE. recom. a clearance of 145′ at center of spans, and Sec. of War, Jan. 17, 1893, prescribed a clearance of 140′ at m. h. w. under the most unfav. conditions at the center of the span of the upper br. Plans in accordance submitted Jan. 19, 1893; approv. Feb. 16, 1893. **93,** 467. New York City, having acquired the rights and franchises of upper br., submitted new plans Jan. 10, 1896; BE. recom., Feb. 26, 1896, a clearance of 135′ at m. h. spring tides, for 200′ on each side of the middle point, and h. of 117′ at least at the pierhead lines; plans in accordance submitted Sept. 15, 1896, approv. Sept. 24, 1896, **97,** 552.

EAST R. (See Stony Creek, Conn.)

EAST R., Green B. City, Wis. (S.) (City br.) PLANS.—Reconstr. plans approv. May 1, 1896, **96,** 426. Modified plans reducing the draw opening approv. Oct. 13, 1896. **97,** 532.

EAST R., Webster Avenue, Green B., Wis. (S.) (City br.) PLANS.—Approv. June 1, 1904, **04,** 719.

EAST R., near Green B., Wis. (S.) (Manitowoc, Green Bay & North Western Ry. Co., Chicago & North Western Ry. Co.) PLANS.—Approv. Mar. 22, 1905, **05,** 726.

EAST THOROUGHFARE, N. J. (S.) (Long Beach Turnpike Co.) PLANS.—Approv. Mar. 14, 1912, **12,** 1306. New plans approv. June 18, 1912, and instrument dated Mar. 14, 1912, canceled, **12,** 1308.

EAST WATERWAY, at Klickitat Avenue, Seattle, Wash. (S.) (Chicago, Milwaukee & Puget Sound Ry. Co.) PLANS.—For trestle br. approv. Aug. 17, 1911, **12,** 1300, 1301.

EBEY SLOUGH, Wash. (See Snohomish R.)

EBEYS SLOUGH, near Marysville, Wash. (S.) (Great Northern Ry. Co.) PLANS.—Reconstr. approv. Jan. 30, 1906, **06,** 804.

EBEY SLOUGH, Snohomish County (sec. 4, T. 28 N., R. 5 E.), Willamette meridian, Wash. (S.) (Chicago, Milwaukee & Puget Sound Ry. Co.) PLANS.—Approv. Aug. 9, 1910, **11,** 1082.

EBEY SLOUGH (sec. 3, T. 28 N., R. 5 E.), Willamette meridian, Wash. (S.) (Snohomish County br.) PLANS.—Approv. Mar. 15, 1912, **12,** 1306.

EDISTO R., near Branchville, S. C. (See Ashley R., etc.) (A.) (State br.) PLANS.—Should be a raft span of at least 60′ in the clear, **89,** 2796.

EDISTO R., near Jacksonboro, S. C. (S.) (Atlantic Coast Line R. R. Co.) PLANS.—Reconstr. of existing br. approv. June 11, 1912, **12,** 1308.

ELBOW RIFFLE. (See Chehalis R.)

ELDER CREEK, N. J. (See Leonards Thoroughfare.)

ELIZABETH R., South First Street, Elizabeth, N. J. (S.) (Union County br.) PLANS.—Approv. Aug. 15, 1907, **08,** 869.

ELIZABETH R., N. J. (S.) (Central R. R. Co. of N. J.) PLANS.—Reconstr. plans approv. Jan. 31, 1911, **11,** 1086.

ELIZABETH R., E. Branch and S. Branch, Va. (S.) (Brs. of Tidewater Ry. Co.) PLANS.—Approv. July 20, 1905, **06,** 801.

ELIZABETH R., E. Branch, Norfolk. Va. (S.) (Norfolk Viaduct Corp.) PLANS.—Approv. Sept. 30, 1905, **06,** 802.

ELIZABETH R., E. Branch at Norfolk, Va., and S. Branch at Gilmerton, Va. (S.) (Norfolk & Western Ry. Co.) PLANS.—Reconstr. approv. Apr. 27, 1906, **06,** 806.

ELIZABETH R., W. Branch, Va. (Dr.) **02,** 581.

ELIZABETH R., Va., E. and S. Branches. (A.) (Norfolk & Western R. R. Co. at Norfolk, Va.) **88,** 2542, 2543, 2622. PLANS.—Details of modification of br. as proposed by the R. R. Co., **88,** 2623. Correspondence in relation thereto, **88,** 2624-2628. Draw opening too narrow and badly located. Draw openings should be 60′ wide and relocated at the deep chan. **88,** 2543.

ELIZABETH R., S. Branch, Va. (S.) (Southern Branch Drawbr. Co.) PLANS.—Approv. Mar. 10, 1899, **99,** 622. Approv. Mar. 14, 1901, in lieu of plans approv. Mar. 10, 1899, **01,** 665.

ELIZABETH R., S. Branch, Norfolk, Va. (S.) (South Eastern & Atlantic R. R. Co.—Location abandoned by the New York, Philadelphia & Norfolk R. R. Co.) **97,** 533; **98,** 534. PLANS.—Grantees' plans approv. Feb. 8, 1897, **97,** 533. Location having been abandoned by grantees, plans of South Eastern & Atlantic R. R. Co., submitted Nov. 12, 1897, approv. Nov. 26, 1897, **98,** 534.

ELIZABETH R., S. Branch, Va. (S.) (Elizabeth R. R. R. Co.) PLANS.—Approv. June 21, 1906, **06,** 808.

ELIZABETH R., W. Branch, between W. Norfolk and Port Norfolk, Va. (S.) (West Norfolk & Port Norfolk Drawbr. Co.) PLANS.—Submitted Feb. 26, 1894; modified June 9, 1894; approv. June 23, 1894, **94,** 429.

ELIZABETH R., W. Branch, Nansemond R. and Cypress Creek, Va. (S.) (Seaboard Traction Co.) PLANS.—Approv. July 7, 1905, **06,** 800.

ELIZABETH R., W. Branch, Norfolk Va. (S.) (Norfolk, Portsmouth & Newport News Ry. Co.) PLANS.—Approv. Feb. 25, 1902, **02,** 587.

ELIZABETH R., W. Branch, near Norfolk, Va. (S.) (Atlantic Coast Line Ry. Co.) PLANS.—Rebuilding approv. Sept. 26, 1905, **06,** 802.

ELK R., Elk R. Mills, Ala. (Sp., etc.) Limestone County br.) LEGISLATION.—County au. to constr. br. under act Sept. 19, 1890, sec. 7, and by act of Alabama, **92,** 402. PLANS.—Approv. Dec. 9, 1891; completion of br. reported in Jan. 27, 1892, **92,** 402.

ELK R., Bedinfield Ferry, near Oliver, Ala. (S.) (Brs. of Limestone and Lauderdale Counties.) PLANS.—Approv. Sept. 1, 1911, **12,** 1301.

ELK R., near mouth of Big Otter Creek, W. Va. (S.) (Clay County br.) PLANS.—Approv. Feb. 5, 1902, **02,** 587.

ELK R., at mouth of Blue Creek, W. Va. (S.) (Imboden & Odell R. R. Co.) PLANS.—Approv. Mar. 16, 1904, **04,** 717.

ELK R. (150′ above mouth of Birch R.), W. Va. (Braxton County br.) PLANS.—Approv. July 22, 1910, **11,** 1082.

ELK R., Charleston, W. Va. (A.) (Suspension wagon br. and Ohio Central R. R. br.) **88,** 2570. PLANS.—Description, **88,** 2572. In view of the nature of the navigation and the limited imp. undertaken by the U. S., Lt. Col. Craighill reported action unnecessary, **88,** 2574.

ELK R., Charleston, W. Va. (S.) (Kanawha & Michigan Ry. Co.) PLANS.—Approv. Oct. 18, 1905, **06,** 802.

ELK R., Charleston, W. Va. (S.) (City br.) PLANS.—Reconstr. approv. Sept. 12, 1905, **06,** 802.

ELK R., Virginia Street, Charleston, W. Va. (S.) (City br.) PLANS.—Reconstr. approv. Dec. 3, 1906, **07,** 823.

ELK R., Spring Street, Charleston, W. Va. (S.) (City br.) PLANS.—Approv. July 31, 1907, **08,** 868.

ELK R., Clay County, W. Va. (S.) (County br.) PLANS.—Approv. Dec. 8, 1898, **99,** 621.

ELK R., Clendennin, W. Va. (S.) (Kanawha County br.) PLANS.—Submitted Feb. 12, 1894; modified June 16, 1894; approv. June 23, 1894. **94,** 429.

ELK R., Frametown, W. Va. (S.) (Braxton County br.) PLANS.—Reconstr. approv. July 31, 1906, **07,** 820.

ELK R., at Gassaway, Braxton County, W. Va. (S.) (Town br.) PLANS.—Approv. Nov. 21, 1911, **12,** 1303.

ELK R., at mouth of Little Otter Creek, W. Va. (S.) (Coal & Coke Ry. Co.) PLANS.—Approv. Nov 11, 1903, **04,** 715.

ELK R., near Yankeedam, W. Va. (S.) (Messrs. Shadle & Auchmuty.) PLANS.—Approv. Jan. 11, 1907, **07,** 824.

ELLIOTT B. and MOUTH OF DUWAMISH R. (waterway between), Wash. (O.) (Seattle & San Francisco R. R. & Navigation Co.)

PLANS.—Alterations to be completed on or before Jan. 1, 1903, **02**, 590.

ELLIOTT B., e. and w. waterways, Seattle and W. Seattle, Wash. (S.) (Seattle Electric Co.) PLANS.—Approv. Sept. 27, 1906, **07**, 822.

ELLIOTT SLOUGH, Aberdeen, Wash. (S.) (City br.) PLANS.—Approv. Oct. 26, 1906, **07**, 822.

ELLIS SLOUGH, near Raymond, Wash. (S.) (Pacific County br.) PLANS.—Approv. Mar. 14, 1907, **07**, 826.

EMBARRASS R., New London, Wis. (S. (Chicago & North Western Ry. Co.) PLANS.—Approv. Jan. 7, 1899, **99**, 621.

EMORY R., Harriman, Tenn. (Sp.) (Tennessee Central R. R. Co.) Au. act June 30, 1902. PLANS.—Approv. July 30, 1902, **03**, 643.

ENGLISH BAYOU, Calcasieu Parish, La. (S.) (Calcasieu Parish br.) PLANS.—Approv. Dec. 24, 1902, **03**, 647.

ENGLISHMAN R., Roque Bluffs, Me. (S.) (Roque Bluffs br.) PLANS.—Reconstr. of existing br. approv. July 29, 1911, **12**, 1300.

ERIE CANAL. (See Black Rock H.)

ESCAMBIA B., CHOCTAWHATCHEE R., and **APPALACHICOLA R.**, between Pensacola and River Junction, Fla. (Sp.) (Louisville & Nashville R. R. Co.) Au. act Mar. 5, 1910. PLANS.—Reconstr. of 3 brs. across the streams mentioned, approv. Mar. 25, 1910, **10**, 1021.

ESSEX R., Essex, Mass. (S.) (Town br.) PLANS.—Reconstr. approv. June 26, 1902, **02**, 589.

EUREKA SLOUGH, Cal. (S.) (Eureka & Klamath R. R. R. Co.) PLANS.—Approv. Mar. 20, 1901, **01**, 665.

EUREKA SLOUGH, Humboldt County, Cal. (S.) (California & Northern Ry. Co.) PLANS.—Approv. June 29, 1900, **00**, 701.

EXETER R., Stratham, N. H. (O. and A.) (Town br.) PLANS.—Specified alterations to be completed on or before May 15 1901, **01**, 668.

F.

FAR ROCKAWAY B., Rockaway Inlet, between Hicks Beach and Shelter Isld., N. Y. (S.) (Ocean Causeway Co.) PLANS.—Submitted Aug. 15, 1894; modified May 9, 1895; approv. July 16, 1895, **95,** 479.

FAR ROCKAWAY B., N. Y. (O.) (Far Rockaway Ferry & Imp. Co.) PLANS.—Alterations requiring a clear draw of 35′ to be completed Oct. 15, 1897, **98,** 538.

FARM CREEK, Bell Isld., Norwalk, Conn. (S.) (Town br.) PLANS.—Rebuilding approv. Oct. 19, 1905, **06,** 803.

FARM CREEK, Norwalk, Conn. (S.) (Connecticut County br.) PLANS.—Reconstr. of existing trestle br. approv. Aug. 21, 1911, **12,** 1301.

FISHING CREEK, N. C. (Sp.) (Frank Hitch.) LEGISLATION.—Mr. Hitch au. to constr. br. by act Mar. 1, 1900, **00,** 697. PLANS.—Approv. Apr. 30, 1900, **00,** 697.

FLAMBEAU R. (N. Fork), Park Falls, Wis. (S.) (Park Falls village br.) PLANS.—Approv. June 28 1909, **09,** 919.

FLINT R., Bainbridge, Ga. (Sp.) (Atlantic Coast Line R. R. Co.) Au. act Aug. 6, 1888. PLANS.—Approv. May 24, 1911. **11,** 1081. Modified plans approv. Oct. 24, 1911, and further modification approv. Apr. 24, 1912, **12,** 1298.

FLINT R., near Bainbridge Ga. (Sp.) (Alabama Midland Ry. Co.) LEGISLATION.—Company au. to constr. br. by act Aug. 6, 1888, **89,** 372. PLANS.—Approv. June 12, 1889, **89,** 372.

FLINT R., Drayton, Ga. (A.) (Wagon br.) PLANS.—Capt. Hoxie recom. the insertion of a draw of suitable width, **88,** 2552.

FLINT R., Decatur, Ga. (Sp.) (Georgia, Florida & Alabama Ry. Co.) Au. act Mar. 1, 1899, and Mar. 2, 1901. PLANS.—Approv. May 22, 1901, **01,** 660.

FLORIDA KEYS (waterways along), from mainland to Key West, including Jew Fish Creek, Bahia Honda, and Indian Key Chans. (S.) (Florida East Coast Ry. Co.) PLANS.—Approv. July 15, 1905, and detailed plans for the localities specified approv. Apr. 4, 1906, **06,** 805.

FLORIDA WATERWAYS, Fla. (Dr.) **11,** 1078.

FLUSHING CREEK, N. Y., near the Bridge Street station on the Whitestone Branch of the Long Island R. R. (O.) (Long Island R. R. Co.) PLANS.—Required a straight chan. practically in direction of the axis of the stream, with a clear width of 40′ in the draw and between the guard piling; to be completed on or before Mar. 1, 1896, **95,** 483.

FLUSHING CREEK, between Newtown and Flushing, Borough of Queens, New York, N. Y. (S.) (City br.) PLANS.—Approv. July 10, 1903, **04,** 713.

FORE R., Me. (Dr.) **02,** 581.

FORE R. MOUTH, Portland H., Me. ("Portland Bridge"). (A. and O.) (Cumberland County br.) PLANS.—Alteration plans, required under act Sept. 19, 1890, approv. Apr. 10, 1893, **93,** 472, 474.

FORE R., Portland H., Me. (Dr.) **10,** 1019.

FORE R., Portland, Me.; Vaughan Br. (O. and A.) (City br.) PLANS.—Specified alterations to be completed on or before Sept. 1, 1902, **01,** 668. Rebuilding approv. Nov. 16, 1905, **06,** 808.

FORE R., Portland, Me. (O. and A.) (Boston & Maine R. R. Co.) **01,** 668. PLANS.—Specified alterations to be completed on or before Sept. 1, 1902, **01,** 668.

FORKED DEER R., Chestnut Bluff, Tenn. (S.) (Br. of Lauderdale and Crockett Counties.) PLANS.—Approv. Oct. 25, 1904, **05,** 724.

FORKED DEER R. (S. Fork of), at S. Fork, Tenn. (S.) (Illinois Central R. R. Co.) PLANS.—Reconstr. approv. Apr. 16, 1906, **06,** 806.

FORKED DEER R., S. Fork, Yellow Bluff, Tenn. (S.) (Dyer County br.) PLANS.—Approv. Sept. 12, 1898, **99,** 620.

FORT BAYOU, Franco Ferry, Miss. (S.) (Jackson County br.) PLANS.—Approv. May 21, 1901, **01,** 666.

FORT BAYOU, main chan., Ocean Springs, Miss. (Sp., etc.) (Ocean Springs Br. Co.) LEGISLATION.—Company au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Mississippi. PLANS.—Approv. Dec. 14, 1891, **92,** 402.

FORT PT. CHAN., Boston, Mass. (S.) (City br.) PLANS.—Approv. Sept. 23, 1897, **98,** 533. Reconstr. approv. July 13, 1911, **12,** 1299.

FORT PT. CHAN., Boston, Mass. (A.) (New York & New England R. R. Co.) PLANS.—Maj. Raymond proposed to widen the draw openings to a least width of 42½′ and to change the direction of the draw p., **88,** 2527. Lt. Col. Gillespie reported that to provide for the proj. increase in chan. depth the existing pivot p. would have to be reconstr. with draw openings of 43′, **88,** 2608, 2609.

FORT PT. CHAN. (Broadway Br.), Boston, Mass. (S.) (City br.) PLANS.—Reconstr. plans for part of p. approv. June 14, 1900, **00,** 701. Rebuilding approv. Mar. 7, 1902, **02,** 587.

FORT PT. CHAN., Boston H., Mass. (S.) (Brs. of the Boston & Providence R. R. Corp., the Old Colony R. R. Co., and the New York, New Haven & Hartford R. R. Co.) PLANS.—For 2 brs. approv. Mar. 28, 1898, **98,** 535.

FORT PT. CHAN., Cove Street, Boston, Mass. (S.) (City br.) PLANS.—Approv. July 10, 1900, **01,** 661. Modified plans approv. Apr. 18, 1902, **02,** 588.

FORT PT. CHAN., Dover Street, Boston, Mass. (S. and O.) (City br.) PLANS.—Reconstr. plans approv. July 12, 1893, **93,** 470. Alterations required by Nov. 30, 1905, **05,** 730.

FORT PT. CHAN., Northern Avenue and Oliver Street, Boston, Mass. (S.) (City br.) PLANS.—Approv. Apr. 11, 1905, **05,** 726.

FORT PT. CHAN. (Across.) (Br. of the Old Colony R. R. Co. at Boston, Mass.) PLANS.—Maj. Raymond reported that the interference with free navigation is caused by delay in opening the draws, due to the great number of passing trains; no alteration of the br. is necessary, **88,** 2527.

FOSTERS MEADOW (Hook Creek) **CANAL,** N. Y. (See Hook Creek.) (S.) (Long Island R. R. Co.) PLANS.—Approv. Sept. 8, 1906, **07,** 822. Approv. Feb. 26, 1907, **07,** 825.

FOUR MILE (Cedar) **CREEK,** at Freeport, Fla. (S.) (Walton County br.) PLANS.—Approv. Mar. 16, 1910, **10,** 1028.

FOURCHE LE FEVRE R., Ark. (Sp.) (Choctaw & Memphis R. R. Co.) LEGISLATION.—Company au. to constr. br. by act Jan. 10, 1899. PLANS.—Approv. Mar. 13, 1899, **99,** 619.

FOURCHE LE FEVRE R., near Esaw, Ark. (S.) (Fourche River Lumber Co.) PLANS.—Approv. Feb. 2, 1904, **04,** 716.

FOURCHE LE FEVRE R., near Houston, Tex. (S.) (Perry County br.) PLANS.—Approv. Aug. 17, 1908, **09,** 914.

FOWL R., Mobile, Ala. (See Dog R.) (S.) (Dauphin Island Ry. & Harbor Co.) PLANS.—Approv. Dec. 12, 1911, **12,** 1303.

FOWL R., Mobile, Ala. (S.) (Mobile West Shore Traction Co.) PLANS.—Approv. Dec. 13, 1911, **12,** 1303.

FOX R., John Street, Appleton, Wis. (See Buffalo Lake.) (S.) (City br.) PLANS.—Rebuilding approv. Sept. 24, 1902, **03,** 646.

FOX R., U. S. Canal, Lake Street, Appleton, Wis. (S.) (City br.) PLANS.—Reconstr. plans of superstr. approv. Oct. 12, 1897, **98,** 533.

FOX R. CANAL, South Division Street, Appleton, Wis. (S.) (City br.) PLANS.—Approv. Jan. 24, 1901, **01,** 664.

FOX R., U. S. Canal, Appleton, Wis. (S.) (City br.) PLANS.—Reconstr. approv. Nov. 3, 1906, **07,** 823.

FOX R., Buffalo, Moundville, and Douglas, Wis. (See below.) (S.) (Marquette County brs.) PLANS.—Approv. Jan. 30, 1901, **01,** 664.

FOX R., near Governors Bend Lock, Wis. (S.) (Fort Winnebago br.) PLANS.—Submitted Aug. 25, 1894; approv. Sept. 15, 1894; modified plans approv. Feb. 6, 1895; br. completed, **95,** 476.

FOX R., Main Street, Green Bay, Wis. (S.) (City br.) PLANS.—Reconstr. plans approv. Oct. 14, 1896, **97,** 532.

FOX R., at Green Bay, Wis. (S.) (Chicago, Milwaukee & St. Paul Ry. Co.) PLANS.—Approv. Mar. 26, 1902, **02,** 588.

FOX R., at Green Bay, Wis. (S.) (Manitowoc, Green Bay & Northwestern Ry. Co.—Chicago & North Western Ry. Co.) PLANS.—Approv. Mar. 27, 1905, **05,** 726.

FOX R., Green Bay, Wis. (S.) (Manitowoc, Green Bay & Northwestern Ry. Co.) PLANS.—Approv. Mar. 27, 1905. Plans in lieu thereof approv. Apr. 25, 1906, **06,** 806.

FOX R., Mason Street, Green Bay, Wis. (O.) (City br.) PLANS.—Approv. Oct. 26, 1908, **09,** 915. Alterations to be completed on or before Mar. 15, 1910, **07,** 829.

FOX R., between Green Bay and Fort Howard, Wis. (S.) (Chicago & North Western Ry. Co. and the Kewaunee, Green Bay & Western R. R. Co.) PLANS.—Approv. Feb. 5, 1895, **95,** 478.

FOX R., at Kimberly, Wis. (S.) (Br. of Outagamie County and village of Kimberly.) PLANS.—Approv. Jan. 29, 1912, **12,** 1305 New plans approv. Mar. 20, 1912, and instrument dated Jan. 29, 1912, canceled, **12,** 1306.

FOX R., at Little Chute, Wis. (S.) (Outagamie County br.) PLANS.—Approv. July 14, 1903, **04,** 713.

FOX R., Menasha, Wis. (S.) (City br.) PLANS.—Reconstr. plans approv. Dec. 29, 1896, **97,** 533.

FOX R., Menasha, Wis. (S.) (City br.) PLANS.—Reconstr. approv. Mar. 20, 1908, **08,** 872.

FOX R., Menasha, Wis. (S.) (Chicago & North Western Ry. Co.) PLANS.—Reconstr. approv. June 16, 1909, **09,** 918.

FOX R., between towns of Moundville and Buffalo, Marquette County, Wis. (Wisconsin Highway Commission.) (See above.) PLANS.—Reconstr. of existing br. approv. Nov. 28, 1911, **12,** 1303.

FOX R. (Little Lake Butte Des Norts), Neenah, Wis. (S.) (Chicago & North Western Ry. Co.) PLANS.—Rebuilding approv. June 16, 1909, **09,** 918.

FOX R., OMRO, Wis. (S.) (Chicago, Milwaukee & St. Paul Ry. Co.) PLANS.—Reconstr. plans approv. Jan. 10, 1899, **99,** 621.

FOX R., Oshkosh, Wis. (S.) (Chicago & North Western Ry. Co.) PLANS.—Reconstr. of plans approv. Sept. 9, 1898, **99,** 620.

FOX R., Wisconsin Avenue, Oshkosh, Wis. (Sp., etc.) (City br.) LEGISLATION.—City au. to constr. br. under act Sept. 19, 1890, sec. 7 and act of Wisconsin. PLANS.—Approv. Feb. 1, 1892, **92,** 403.

FOX R., at Oshkosh, Wis. (S.) (Wisconsin Central Ry. Co.) PLANS.—For br. to replace existing str. approv. July 2, 1902, **03,** 645.

FOX R., Main Street, Oshkosh, Wis. (S.) (City br.) PLANS.—Rebuilding approv. July 7, 1904. **05,** 722.

FOX R., Portage (about 4 m. below), Wis. (S.) (Minneapolis, St. Paul & Sault Ste. Marie Ry. Co.) PLANS.—Reconstr. approv. Jan. 22, 1910, **10,** 1026.

FOX R., Princeton, Wis. (S.) (Princeton & Northwestern Ry. Co.) PLANS.—Approv. Sept. 14, 1900, **01,** 663.

FOX R., Wrightstown, Wis. (S.) (Brown County br.) PLANS.—Partial rebuilding approv. July 25, 1900, **01,** 662.

FOX R. and **CANAL,** De Pere, Wis. (S.) (De Pere City br.) PLANS.—New br. approv. Feb. 1, 1894, **94,** 427.

FOX R. and **U. S. CANAL,** De Pere, Wis. (Sp., etc.) (Chicago & North Western Ry. Co.) LEGISLATION.—Company au. to constr. br. under act July 13, 1892, sec. 3, and act of Wisconsin, **92,** 409. PLANS.—Modified plan approv. Aug. 30, 1892, **92,** 409. New br. approv. Nov. 21, 1903, **04,** 715.

FOX R. CANAL, Main Street, De Pere, Wis. (O. and A.) (City br.) LANS.—Specified alterations to be completed on or before May 1 1901, **01,** 668.

FOX R. and **CANAL,** Kaukauna, Wis. (S.) (City br.) PLANS.—Approv. Dec. 11, 1893. Reported completed. **94,** 427.

FOX R. CANAL, Lock No. 2, Kaukauna, Wis. (S.) (Chicago & North Western Ry. Co.) PLANS.—Reconstr. approv. Sept. 7, 1900, **01,** 662.

FOX R. CANAL, Lawe Street and Wisconsin Avenue, Kaukauna, Wis. (O. and A.) (City brs.) PLANS.—Specified alterations to be completed on or before May 1, 1901, **01,** 668.

FOX R. (U. S. Canal along), Menasha, Wis (S.) (Chicago, Milwaukee & St. Paul Ry. Co.) PLANS.—Reconstr. approv. Jan. 25, 1905, **05,** 725.

FOX R. CANAL, Mill Street and Taco Street, Menasha, Wis. (O. and A.) (City brs.) PLANS.—Specified alterations to be completed on or before May 1, 1901, **01,** 668.

FOX R. CANAL, Montello, Wis. (S.) (Montello village br.) PLANS.—Approv. Jan. 27, 1905, **05,** 725.

FOX R. and the **PORTAGE CANAL,** Wis. (A.) PLANS.—List of brs. obstr. the R. and the canal; remedies or modifications proposed by Capt. Marshall, **88,** 2578, 2579.

FRANKFORD CREEK, Pa. (See Schuylkill R., etc.) (O.) (Kensington & Tacony R. R.—Pennsylvania R. R. Co.) PLANS.—Required a clear chan. width of 24′ and h. w. clearance of 10′ on or before Oct. 31, 1900, **00,** 703.

FRANKFORD CREEK, Philadelphia, Pa. (S.) (Philadelphia Belt Line R. R. Co.) PLANS.—Approv. Sept. 30, 1892, **93,** 466.

FRANKFORD CREEK, Bridge Street, Philadelphia, Pa. (S.) (City br.) PLANS.—Reconstr. of br. approv. Jan. 7, 1895, **95,** 477.

FRENCH CREEK, W. Va. (S.) (Baltimore & Ohio R. R. Co.) PLANS.—Rebuilding approv. Dec. 3, 1909, **10,** 1025.

G.

GALENA R., at Galena Junction, Ill. (S.) (Chicago, Burlington & Quincy Ry. Co.) PLANS.—Reconstr. plans approv. Sept. 13, 1910, **11,** 1083.

GALENA R., Ill. (Dr.) **02,** 581; **09,** 912.

GALLINAS CREEK, Marin County, Cal. (S.) (Bay Counties Ry. Co.) PLANS.—Approv. July 14, 1906, **07,** 820.

GALVESTON B. (See West Galveston B.)

GALVESTON B., Tex., between Galveston Isld. and Virginia Pt. (Sp.) (La Port, Houston & Northern R. R. Co.) LEGISLATION.—Company au. to constr. br. by act Feb. 1, 1895. PLANS.—Approv. Mar. 27, 1895; draw opening required to be 85′ in the clear, **95,** 475.

GALVESTON B., Tex., between Galveston Isld. and Virginia Pt. (S.) (Port Bolivar, Galveston & Virginia Point Terminal R. R. Co.) PLANS.—Approv. Mar. 25, 1895, **95,** 478.

GASCONADE R., Mo. (A.) (Missouri Pacific R. R. Co.) PLANS.—Description of the br. Maj. Miller reported that the draw span should be made operative, and that a guide p. should be built above and below the pivot p. 88, 2559.

GASCONADE R., Mo. (S.) (St. Louis, Kansas City & Colorado R. R. Co.) PLANS.—Approv. July 13, 1901, **02,** 583.

GASCONADE R., Rollins Ferry Mo. (S.) (Osage County br.) PLANS.—Modified plans approv. Oct. 19, 1897, **98,** 533.

GASPARILLA SOUND, at Gasparilla Isld., Fla. (S.) (Alafia, Manatee & Gulf Coast Ry. Co.) PLANS.—Approv. May 4, 1906, **06,** 806.

GAULEY R., W. Va. (S.) (Chesapeake & Ohio R. R. Co.) PLANS.—Approv. Dec. 21, 1892, **93,** 467.

GAULEY R., Fayette County, W. Va. (Sp., etc.) (Kanawha & Michigan (Ohio) Ry. Co.) LEGISLATION—Company au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of West Virginia. PLANS.—Modified plans approv. Aug. 11, 1892, **92,** 408.

GENESEE R., Charlotte, N. Y. (Sp.) **74,** 71, 583. BE. convened at Charlotte, N. Y., Aug. 26, 1873, approv. location and plan, with certain modifications. **R., 74,** 584. Approv. by Chief of Engineers, except regulations for government of operating draw, **74,** 583. Approv. by Sec. of War, **74,** 584. (Majs. Merrill, Wilson, and Harwood.) LEGISLATION.—Br. au. by act Mar. 3, 1873, **74,** 583. PLANS.—Submitted by Lake Ontario Shore R. R. Co., referred to BE., **74,** 583.

GENESEE R., Charlotte, N. Y. (S.) (New York Central & Hudson R. R. R. Co.) PLANS.—Rebuilding approv. Apr. 12, 1904, **04,** 717.

GEORGIANA SLOUGH, Walnut Grove, Cal. (S.) (Sacramento County br.) PLANS.—Approv. Oct. 17, 1899, **00,** 699.

GILPATRICKS COVE, Northeast Harbor, Me. (S.) (W. W. Vaughan.) PLANS.—Approv. Sept. 13, 1895, **96,** 424.

GLOUCESTER H. (canal at entrance of) to **ANNISQUAM R.,** Gloucester, Mass. (S.) (Essex County brs.) PLANS.—Temporary and permanent brs. approv. Sept. 14 and Dec. 6, 1905, respectively, **06,** 803.

GOODBYS LAKE (Creek), Duval County, 8 m. above Jacksonville, Fla. (S.) (County br.) PLANS.—Approv. Nov. 3, 1911, **12,** 1302.

GOWANUS CANAL, Hamilton Avenue, 9th Street, 3d Street, and Union Street, Borough of Brooklyn, New York, N. Y. (S.) (City brs.) PLANS.—Rebuilding existing strs. approv. May 5, 1904, **04,** 718.

GRAND BAYOU, on line of logging road in Louisiana. (Bowie Lumber Co., Ltd.) PLANS.—Approv. Aug. 19, 1910, **11,** 1083.

GRAND R., Mich. (Dr.) **07,** 815; **10,** 1019.

GRAND R., Ohio. (S.) (Lake County br.) PLANS.—For new br. approv. Apr. 14, 1899, **99,** 622.

GRAND R., near Bass R., Mich. (S.) (Riverside Ry. Co.) PLANS.—Approv. Nov. 19, 1904, **05,** 725.

GRAND R., Brunswick Mo. (S.) (Chariton County br.) PLANS.—Approv. Nov. 30, 1907, **08,** 871.

GRAND R., near Grand Haven, Mich. (S.) (Detroit, Grand Haven & Milwaukee Ry. Co.) PLANS.—Reconstr. approv. Sept. 30, 1907, **08,** 870.

GRAND R., Wealthy Avenue, Grand Rapids, Mich. (A.) (Pere Marquette R. R. Co.) PLANS.—Reconstr. approv. Aug. 31, 1901, **02,** 590.

GRAND R., Wealthy Avenue, Grand Rapids, Mich. (S.) (City br.) PLANS.—Approv. Oct. 16, 1902, **03,** 646.

GRAND R., Painesville, Ohio. (S.) (Baltimore & Ohio R. R. Co.) PLANS.—Reconstr. approv. Dec. 22, 1906, **07,** 824.

GRAND R., between Spring Lake and Grand Haven, Mich. (S.) (Grand River Toll Bridge

Co.) PLANS.—To replace existing str. approv. Mar. 25, 1903, **03**, 649.

GRAND CALUMET R., at Hohman Avenue, Hammond, Ind. (Sp.) (Lake County br.) Au. act Apr. 8, 1910. PLANS.—Approv May 10, 1910, **10**, 1022.

GRANDE BAYOU, arm of Pensacola B., Fla. (S.) (Pensacola Electric Ry. Co.) PLANS.—Reconstr. approv. Sept. 23, 1905, **06**, 802.

GRASSE R., at Messena Center, N. Y. (S.) (Town br.) PLANS.—Approv. Aug. 4, 1909, **10**, 1023.

GRASSY SOUND CHAN., in line of road to Holly Beach, N. J. (S.) (Cape May County br.) PLANS.—Approv. Mar. 28, 1911, **11**, 1088.

GRAVENS THOROUGHFARE, N. J. (S.) (Cape May County br.) PLANS.—Approv. Mar. 4, 1912, **12**, 1305.

GREAT CHAN. and **SCOTCH BONNET THOROUGHFARE**, N. J. (S.) (Brs. of Stone Harbor Turnpike Co.) PLANS.—Approv. Aug. 10, 1910, and modified plans extending sand fill at br. across Great Chan. approv. Aug. 29, 1910, **11**, 1082.

GREAT EGG H., between Somers Pt. and Ocean City, N. J. (S.) (Atlantic City & Ocean City R. R. Co.) PLANS.—Approv. Nov. 3, 1906, **07**, 823.

GREAT KANAWHA R., Charleston, W. Va. (A.) **83**, 271, 1591; **84**, 271, 1796. COMMERCE.—Requirements of C., **83**, 1593; **84**, 1804. BE. recom. chan. span with clear opening of 400′ and its lowest part at least 29′ above the h. w. and 75′ above l. w., **84**, 1798. (Lt. Cols. Craighill and Merrill and Capt. Post.) LEGISLATION.—Changes recom. by BE., **84**, 1798, 1802. PLANS.—Col. W. P. Craighill reported chan. span should not be less than 250′ clear opening, height of spans not less than 70′, **83**, 1592. Dimensions of spans referred to BE., **84**, 1797. Recom. of board, **84**, 1797.

GREAT KANAWHA R., Charleston, W. Va. (Sp.) (Charleston & South Side Bridge Co.) BE. constituted by S. O. No. 28, May 31, 1890. (Col. W. P. Craighill, Maj. D. W. Lockwood, and Capt. E. Maguire.) LEGISLATION.—Company au. to constr. br. under act Mar. 3, 1887. PLANS.—Revised plans conforming to the recom. of the BE. approv. Sept. 26, 1890. Apr. 20, 1891, Col. Craighill reported br. completed as required, except that the main span was $\frac{1}{16}$″ too low at Charleston end. **91**, 429.

GREAT KANAWHA R., Pt. Pleasant, W. Va. (Sp.) (Ohio River R. R. Co.) **88**, 308. BE. Board of 1887 recom. location of br. with a clear opening of 460′, as proposed by the Ohio River R. R. Co., **88**, 2448. (Col. Craighill, Lt. Col. Merrill, and Maj. Post.) LEGISLATION.—Act au. constr. of br., Mar. 3, 1887, **88**, 2447.

GREAT PEDEE R., 125 m. above Georgetown, S. C. (A.) (Wilmington, Columbia & Augusta R. R. Co.) PLANS.—Capt. Bixby recom. suitable fenders at both ends of the draw openings of the br., extending 100′ above and below the br., **88**, 2547.

GREAT PEDEE R., at Savage and Allisons Landing, S. C. (S.) (Pee Dee Br. Co.) PLANS.—Approv. Oct. 5, 1911, **12**, 1301.

GREAT PEDEE R., near Society Hill, S. C. (O.) (Society Hill & Marlborough Br. Co.) PLANS.—Specified alterations required on or before Sept. 1, 1892, **92**, 411. Alterations to be completed on or before 60 days from Feb. 26, 1908, **08**, 874.

GREAT RIGOLETS, La., br. (R. R.). **70**, 63, 377. LEGISLATION.—Committee on C. (of U. S. Senate) requested, May 5, 1870, the views of Sec. of War, **70**, 377. PLANS.—New Orleans, Mobile & Chattanooga R. R. Co.'s plan discussed, **70**, 379. Objections to the br. stated by Maj. Reese, **70**, 379. By Chief of Engineers, **70**, 378. Suggestions for the imp. of the plan in interests of navigation, **70**, 380.

GREEN R., Munfordville, Ky. (S.) (Munfordville Br. Co.) PLANS.—Approv. Oct. 25, 1906, **07**, 822.

GREEN R., at Smallhouse, Ky. (S.) (Madisonville, Hartford & Eastern R. R. Co.) PLANS.—Approv. Feb. 19, 1906, **06**, 804.

GREEN R. (below Lock No. 1), Spottsville, Ky. (O.) (Louisville, St. Louis & Texas R. R. Co.) PLANS.—Widening w. draw opening to 160′ and placing w. p. 52′ w. of position; to be completed on or before July 31, 1891; time extended to Oct. 31, 1891, **91**, 434.

GROSSETETE BAYOU, between Grosse Tete and Rosedale, La. (S.) (Iberville Parish Br.) PLANS.—Approv. Sept. 3, 1909, **10**, 1024.

GROSSETETE BAYOU, near Grosse Tete, La. (S.) (Morgan's Louisiana & Texas R. R. & S. S. Co.) PLANS.—Approv. Apr. 4, 1906, **06**, 805.

GUADALUPE R., Kemper City, Tex. (S.) (St. Louis, Brownsville & Mexico Ry. Co.) PLANS.—Approv. May 3, 1905, **05**, 727.

GUNPOWDER R., Md. (S.) (Philadelphia, Baltimore & Washington R. R. Co.) PLANS.—Reconstr. of existing br. approv. Mar. 19, 1912, **12**, 1306.

GUT, at South Bristol, Me. (O.) (Bristol town br.) PLANS.—Alterations to be completed on or before July 30, 1903, **03**, 652.

GUYANDOT R., W. Va. (See Ohio R., etc.) (S.) (Guyandot Valley Ry. Co.) PLANS.—For 2 brs., 14½ m. and 20½ m., respectively, above the mouth of the Guyandot, approv. Mar. 24, 1900, **00**, 700.

GUYANDOT R., at Baileysville, W. Va. (S.) (Wyoming County br.) PLANS.—Approv. June 19, 1912, **12**, 1308.

GUYANDOT R., Barboursville, W. Va. (S.) (Cabell County br.) PLANS.—Approv. Nov. 17, 1908, **09**, 816.

GUYANDOT R., Branchland, W. Va. (S.) (Guyan Br. Co.) PLANS.—Approv. Mar. 31, 1908, **08,** 872.

GUYANDOT R., Guyandot and Huntington, W. Va. (S.) (Cabell County br.) PLANS.—Approv. Mar. 15, 1905, **05,** 726.

GUYANDOT R., Lincoln County, W. Va. (S.) (Lincoln County br.) PLANS.—Approv. Oct. 13, 1902, **03,** 646.

GUYANDOT R., Logan, W. Va. (S.) (Logan & Southern Ry. Co.) PLANS.—Approv. Sept. 1, 1908, **09,** 915.

GUYANDOT R., near Logan Courthouse, W. Va. (S.) (Manley Coal Co.) PLANS.—Approv. Sept. 21, 1909, **10,** 1024.

GUYANDOT R., above mouth of Russell Creek, W. Va. (S.) (Cabell County br.) PLANS.—Approv. Oct. 3, 1911, **12,** 1301.

GUYANDOT R., Salt Rock, W. Va. (S.) (Cabell County br.) PLANS.—Approv. Nov. 1, 1897, **98,** 533.

H.

HACKENSACK R., N. J. (S.) (Pennsylvania R. R. Co.) PLANS.—Submitted Sept. 22, 1892, for replacing old with new br.; approv. Oct. 20, 1892, **93**, 466.

HACKENSACK R., N. J. (S.) (Morris & Essex R. R. Co.) PLANS.—For new br. approv. May 21, 1900, **00**, 701.

HACKENSACK R., N. J. (Dr.) **02**, 581; **10**, 1019.

HACKENSACK R., N. J. (S.) (County br.) PLANS.—Approv. Feb. 18, 1901, **01**, 665.

HACKENSACK R., N. J. (S.) (Hudson County br.) PLANS.—To replace existing str. approv. Aug. 10, 1903, **04**, 713.

HACKENSACK R., N. J. (S.) (Central R. R. of N. J.) PLANS.—Temporary br. for use during reconstr. of existing br. approv. July 7, 1911, **12**, 1299.

HACKENSACK R., N. J. (S.) (Central R. R. of N. J.) PLANS.—Approv. June 19, 1911; instrument canceled Mar. 22, 1912, and new plans approv. Mar. 22, 1912, **12**, 1306.

HACKENSACK R., Hackensack, N. J. (S.) (Bergen County Traction Co.) PLANS.—Approv. Jan. 4, 1900, **00**, 700.

HACKENSACK R., Anderson Street, Hackensack N. J. (S.) (Bergen County br.) PLANS.—Reconstr. plans approv. Mar. 14, 1898, **98**, 534.

HACKENSACK R., Court Street, Hackensack, N. J. (S.) (Bergen County br.) PLANS.—Rebuilding approv. July 24, 1908, **08**, 868.

HACKENSACK R., Hackensack and Ridgefield Park, N. J. (S.) (Bergen County br.) PLANS.—Approv. Dec. 12, 1908, **09**, 916. Modified plans approv. Dec. 18, 1911, **12**, 1303.

HACKENSACK R., Newark Avenue, Jersey City, N. J. (S.) (Hudson County br.) PLANS.—Rebuilding approv. July 20, 1906, **07**, 820; and plans supple. thereto approv. Aug. 22, 1908, **09**, 915.

HACKENSACK R., Little Ferry, N. J. (S.) (Bergen Turnpike Co.) PLANS.—Approv. Aug. 29, 1901, **02**, 584.

HACKENSACK R., Marion, N. J. (S.) (Pennsylvania, New Jersey & New York R. R. Co.) PLANS.—Approv. June 29, 1905, **05**, 728.

HACKENSACK R., Secaucus, N. J. (S.) (Erie Terminals R. R. Co.) PLANS.—Approv. Mar. 16, 1910, **10**, 1028.

HACKENSACK R., near Snake Hill, N. J. (S.) (Erie R. R. Co.—New York & Greenwood Lake Ry. Co.) PLANS.—Reconstr. approv. May 15, 1907, **07**, 827.

HACKENSACK and **PASSAIC RS.**, N. J. (S.) (Central R. R. of N. J.) PLANS.—Reconstr. plans for 2 brs. approv. June 19, 1911, and plans for 2 temporary brs. alongside approv. July 7, 1911, **11**, 1090.

HALIFAX R., Daton, Fla. (S.) (J. P. Vining et al.) PLANS.—Approv. May 15, 1901, **01**, 666.

HALIFAX R., Fla., to connect Daytona with Daytona Beach and Seabreeze. (S.) (Michael Sholtz.) PLANS.—Approv. May 4, 1912, **12**, 1307.

HALIFAX R., at Ormond, Fla. (S.) (Florida East Coast Ry. Co.) PLANS.—Approv. Aug. 3, 1904, **05**, 723.

HALIFAX R., Port Orange, Fla. (S.) (Port Orange Br. Co.) PLANS.—Approv. Aug. 7, 1905, **06**, 801.

HAMMONASSET R. (See Stony Creek, Conn.)

HAMPTON CREEK (arm of), Hampton, Va. (S.) (City br.) PLANS.—Approv. Aug. 23, 1910, **11**, 1083.

HAMPTON R., Seabrook Beach to Hampton Beach, Me. (S.) (Granite State Land Co.) PLANS.—Approv. Apr. 15, 1901, **01**, 666.

HARLEM KILLS. (See East R.)

HARLEM R., Broadway crossing, N. Y. (S.) (New York City br.) LEGISLATION.—Congress, act Sept. 19, 1890, required submission of plans. PLANS.—Submitted Apr. 28, 1892; modified plans Jan. 31, 1893; approv. Feb. 11, 1893, **93**, 467. Reconstr. approv. Apr. 20, 1905, **05**, 727.

HARLEM R., Broadway extended, New York City, N. Y. (Sp., etc.) (Hugh N. Camp and D. E. Seybel.) PLANS.—Permission to build temporary footbr. granted June 24, 1892, by revocable license, **92**, 406.

HARLEM R., 1st Avenue, New York, N. Y. (S.) (City br.) PLANS.—Approv. Jan. 11, 1895, **95**, 477.

HARLEM R., 4th Avenue, New York, N. Y. (Sp., etc.) (New York Central & Hudson River R. R. Co.) LEGISLATION.—Company au. to constr. br. under act Sept. 19, 1890, and act of New York, **92**, 406. PLANS.—Reconstr. plans for a temporary br., approv. May 27, 1892, and for a permanent br., approv. Aug. 5, 1892, **92**, 406.

HARLEM R., N. Y. (Dr.) **02**, 581.

HARLEM R., New York City. (A.) **90**, 344. COMMERCE.—Interest involved, **90**, 3486. BE. convened at New York City, June 19, 1890, by S. O. No. 25, to report upon alleged obstr. of navigation by certain brs. over the Harlem

R. Board recom. increasing the clear headway of the 3d and 4th Avenue brs. to 24′ above h.-w. level., **90**, 3487. (Cols. Abbot and Comstock and Lt. Col. Gillespie.) LEGISLATION.—Notice served as to alterations required, **90**, 344.

HARLEM R., between 145th and 149th Streets, New York. (S.) (New York City br.) PLANS.—Approv. Nov. 11, 1897, **98**, 533.

HARLEM R., 155th Street, and McComb Dam Road, New York. (Sp.) (New York City Commissioners of Public Parks.) LEGISLATION.—Commissioners au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of New York. PLANS.—To replace the McComb Dam br. approv. Sept. 7, 1891, **91**, 433.

HARLEM R., 156th Street, New York City, N. Y. (O.) (City br.) PLANS.—Permission for temporary br. granted by revocable license, July 5, 1892; this temporary br. to be removed upon completion of permanent br. at 155th Street, **92**, 406. Br. at 155th Street completed; notice served, Apr. 13, 1897, requiring removal of temporary br. at 156th Street within 90 days, **97**, 536.

HARLEM R., 3d Avenue, New York, N. Y. (S.) (City br.) PLANS.—Br. obstr. navigation; city notified, July 2, 1890, to alter it; alteration plans approv. Mar. 24, 1893, **93**, 469.

HARLEM R., between 145th Street and 149th Street, New York, N. Y. (S.) (City br.) PLANS.—Approv. Oct. 6, 1900, in lieu of plans approv. Nov. 11, 1897, **01**, 663.

HARLEM R., between Boroughs of Manhattan and The Bronx, New York, N. Y. (S.) (City br.) PLANS.—Approv. Aug. 22, 1907, **08**, 869.

HARLEM R., 138th Street, New York, N. Y. (S.) (City br.) PLANS.—Reconstr. and temporary br. during progress of work, approv. Aug. 28, 1905, **06**, 801.

HARLEM R., 207th Street, New York, N. Y. (S.) (City br.) PLANS.—Approv. Sept. 4, 1903, **04**, 714.

HARVEY CANAL, La. (Dr.) **08**, 865.

HATCHEE R., Lauderdale County, Tenn. (S.) (Illinois Central R. R. Co., lessee of Chicago, St. Louis & New Orleans R. R. Co.) PLANS.—Reconstr. approv. Nov. 18, 1903, **04**, 715.

HELL GATE (Little Hell Gate) and **BRONX KILLS**, N. Y. (S.) (New York Connecting R. R. Co.) PLANS.—Approv. Mar. 2, 1901, **01**, 665.

HELL GATE. (See East R.)

HENDERSON B. (arm of), Purdy, Wash. (S.) (Pierce County br.) PLANS.—Approv. Oct. 28, 1904, **05**, 724.

HERRING B., Md. (See Traceys Creek.)

HIGGINS SLOUGH, Wash. (S.) (Chehalis County br.) PLANS.—Approv. Apr. 3, 1907, **07**, 826.

HILLEBRANDT BAYOU, Tex. (S.) (Jefferson County br.) PLANS.—Approv. Mar. 30, 1897, **97**, 533.

HILLSBORO B., Tampa, Fla. (S.) (Tampa Terminal Co.) PLANS.—Approv. Oct. 26, 1906, **07**, 822.

HILLSBORO B. (inlet of), near Tampa, Fla. (S.) (Tampa Northern R. R. Co.) PLANS.—Approv. Jan. 28, 1907, **07**, 824.

HILLSBORO R., 11 m. above mouth, Fla. (S.) (Tampa Northern R. R. Co.) PLANS.—Approv. Jan. 26, 1907, **07**, 824.

HILLSBORO R., Fla. (Dr.) **05**, 719.

HILLSBORO R., near Nebraska Avenue Road, Hillsboro County, Fla. (S.) (Tampa & Sulphur Springs Traction Co.) PLANS.—Approv. July 31, 1907, **08**, 868.

HILLSBORO R., Tampa, Fla. (S.) (City br.) PLANS.—Rebuilding br. approv. June 22, 1895, **95**, 479. Reconstr. approv. Oct. 26, 1911, **12**, 1302.

HILLSBORO R., at Tampa, Fla. (S.) (Atlantic Coast Line R. R. Co.) PLANS.—Repairs approv. July 15, 1909, **10**, 1023. Falsework plans approv. Jan. 6, 1912, **12**, 1304.

HILLSBORO R., above Tampa, Fla. (S.) (Hillsboro County br.) PLANS.—Approv. May 14, 1910, **10**, 1030.

HILLSBORO R., Tampa, Fla. (S.) (Savannah, Florida & Western Ry. Co.) PLANS.—Approv. Oct. 23, 1893, **94**, 426.

HILLSBORO R., W. 9th Street, Tampa, Fla. (S.) (Tampa & Sulphur Springs Traction Co.) PLANS.—Approv. May 22, 1908, **08**, 872.

HIWASSEE R., Charleston, Tenn. (S.) (Brs. of Bradley and McMinn Counties, Tenn.) PLANS.—Approv. Aug. 3, 1911, **12**, 1300.

HIWASSEE R., near mouth of Ocoee R., Tenn. (S.) (Louisville & Nashville R. R. Co.) PLANS.—Approv. Dec. 30, 1904, **05**, 725.

HIWASSEE R., above mouth of Ocoee R., Tenn. (S) (Polk County br.) PLANS.—Approv. June 13, 1911, **11**, 1090. Modified plans approv. Oct. 5, 1911, **12**, 1301.

HIWASSEE R., Gamble Shoal, Tenn. (S.) (Polk County br.) PLANS.—Approv. Jan. 26, 1906, **06**, 804.

HOGANS CREEK, near Jacksonville, Fla. (S.) (Seaboard Air Line Ry. Co.) PLANS.—Rebuilding an existing br. (Upper Hunter Terminal Br.) and plans of new br. (Corse Br.) approv. July 13, 1909, **10**, 1023.

HOLSTON R. (Boyds Ferry), near Knoxville, Tenn. (Knoxville County br.) PLANS.—Approv. Aug. 2, 1893, **93**, 470. Modified plan approv. Nov. 29, 1893, **94**, 427.

HOLSTON R., Brabsons Ferry, Tenn. (S.) (Southern Ry. Co.) PLANS.—Approv. Aug. 10, 1906, **07**, 821.

HOLSTON R., near Millers Isld., 3 m. below Surgoinsville, Tenn. (S.) (Holston River Ry. Co.) PLANS.—Approv. Nov. 28, 1906, **07**, 823.

HOLSTON R., N. Fork, near Kingsport, Tenn. (Sp.) (South & Western R. R. Co.) Au. act

May 12, 1906. PLANS.—Approv. Dec. 4, 1906, **07,** 817.

HOLSTON R., near Rogersville and Churchill, Tenn. (S.) (Hawkins County br.) PLANS.—Approv. Aug. 10, 1909, **10,** 1024.

HOLSTON R., S. Fork, near Kingsport, Tenn. (Sp.) (South & Western R. R. Co.) Au. act May 12, 1906. PLANS.—Approv. Dec. 4, 1906, **07,** 817.

HOLSTON R., near Straw (Strawberry) Plains, Tenn. (S.) (Southern Ry. Co.) PLANS.—Approv. June 27, 1906, **06,** 808.

HOOK CANAL, mouth of Hook Creek, N. Y. (O.) (Jamaica & Rockaway Turnpike Co.) PLANS.—Alterations to be completed on or before Dec. 1, 1904, **05,** 730.

HOOK CREEK, Long Isld., N. Y. (S.) (W. C. Baker.) PLANS.—Approv. May 10, 1902, **02,** 588.

HOOK CREEK, Meadowmere, N. Y. (S.) (W. C. Baker.) PLANS.—Br. to replace existing str. approv. May 10, 1905, **05,** 727.

HOOK CREEK, between the City of New York and Hempstead, N. Y. (S.) (Margaret A. Hill.) PLANS.—Approv. May 6, 1909, **09,** 918.

HOOK CREEK (Fosters Meadow Canal), on Jamaica and South Shore R. R. (S.) (Long Island R. R. Co.) PLANS.—Approv. Mar. 21, 1911, **11,** 1087.

HOQUIAM R., Wash. (S.) (United railroads of Washington.) PLANS.—Approv. Oct. 2, 1897, **98,** 533.

HOQUIAM R., Chehalis County, Wash. (S.) (Northern Pacific Ry. Co.) PLANS.—Approv. Apr. 20, 1907; modified plans in lieu thereof approv. Sept. 10, 1907, **08,** 869, 870.

HOQUIAM R., Hoquiam, Wash. (S.) (City br.) PLANS.—Approv. Dec. 19 1899, **00,** 700.

HOQUIAM R., Hoquiam, Wash., and **WISHKA R.,** Aberdeen, Wash. (S.) (Northern Pacific Ry. Co.) PLANS.—Reconstr. approv. Apr. 20, 1907, **07,** 826.

HOQUIAM R., Hoquiam, Wash. (S.) (Grays Harbor & Puget Sound Ry. Co.) PLANS.—Approv. Dec. 12, 1908, **09,** 916.

HOQUIAM R., Hoquiam, Wash. (S.) (City br.) PLANS.—Reconstr. approv. Oct. 16, 1909, **10,** 1024.

HOQUIAM R., at Ramer Avenue, Hoquiam, Wash. (S.) (City br.) PLANS.—Approv. June 17, 1910, **10,** 1030.

HOUSATONIC R. (See Cosoob, etc.)

HOUSATONIC R., Stratford, Conn. (A.) (Highway.) **88,** 2611. PLANS.—Description. Lt. Col. Houston recom. fifth and sixth spans be made draw spans. **88,** 2612.

HOUSATONIC R., between Stratford and Milford, Conn. (O.) (Washington Br., Fairfield and New Haven Counties.) PLANS.—Specified alterations required on or before Dec. 1, 1893. Board of commissioners decided to build new br. **93,** 474.

HOUSATONIC R., between Milford and Stratford, Conn. (S.) (New York, New Haven & Hartford R. R. Co.) PLANS.—Rebuilding approv. May 12, 1904, **04,** 718.

HOUSTON R., Calcasieu Parish, La. (S.) (Kansas City, Shreveport & Gulf Ry. Co.) PLANS.—For new br. approv. Oct. 18, 1899, **00,** 699.

HUDSON R., Albany, N. Y. (Dr.) **05,** 719.

HUDSON R., at New York City. (Sp.) **91,** 433. BE. convened to consider and report upon plan of br., **91,** 3853. Recom. clear headway at the middle of the span above h. w. of spring tides be increased in the plans to not less than 150′, **91,** 3859. (Cols. Abbot, Comstock, and Houston, and Lt. Col. Gillespie.) LEGISLATION.—Br. au. by act July 11, 1890; requirements of the act, **91,** 3853.

HUDSON R., N. Y. (Dr.) **11,** 1078.

HUDSON R., New York City, N. Y. (Sp.) (New York & New Jersey Br. Co.) LEGISLATION.—Companies au. to constr. br. by act June 7, 1894, **96,** 423. PLANS.—Submitted June 4, 1895; approv. without date, contingent upon report of board of harbor lines, 1896, which recom., Feb. 28, 1896, revised plans of approaches and map of location; approv. Mar. 13, 1896, **96,** 423. Detailed plans submitted Mar. 10, 1897; approv. May 24, 1899, **99,** 619.

HUDSON R., near 23d Street, New York City, N. Y. (Sp., etc.) (North River Br. Co.) PLANS.—Modified plans, conforming to the requirements as to height fixed by the War Dept., approv. Dec. 29, 1891, **92,** 403.

HUDSON R., New York, N. Y. (Sp.) (New York & New Jersey Br. Co.) Au. act May 24, 1899. PLANS.—Modification of detailed plans approv. July 3, 1900, **01,** 659.

HUDSON R., Poughkeepsie, N. Y. (S.) (Central New England Ry. Co.) PLANS.—Reconstr. approv. Aug. 17, 1906, **07,** 821.

HUDSON R., Troy, N. Y. (O. and A.) (Delaware & Hudson Co.—Rensselaer & Saratoga R. R. br.) PLANS.—Alterations to be completed on or before 1 year from date of service of notice, Apr. 29, 1901, **01,** 669.

HUMPTULIPS R., Wash. (A.) (Northern Pacific Ry. Co.) PLANS.—Reconstr. approv Mar. 30, 1903, **03,** 651.

HUMPTULIPS R., Chehalis County, Wash. (S.) (Chehalis County br.) PLANS.—Approv. Sept. 28, 1903, **04,** 714; and Apr. 3, 1907, **07,** 826.

HUNTING CREEK, Alexandria, Va. (Sp., etc.) (Washington, Alexandria & Mount Vernon Electric Ry. Co.) LEGISLATION.—Company au. to constr. br. under act July 13, 1892, sec. 3, and act of Virginia. PLANS.—Approv. Aug. 20, 1892, on condition that the width of draw opening be increased to 40′ when so desired by the Sec. of War, **92,** 409.

HURON R., Huron, Ohio. (Sp. etc.) (Lake Shore & Michigan Southern Ry. Co.) LEGISLATION.—Company au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Ohio. PLANS.—Approv. Dec. 18, 1891, **92**, 402.

HURON R., at Van Ransselaer Street, Huron, Ohio. (S.) (Br. of Erie County, Ohio.) PLANS.—Br. to replace existing one approv. Feb. 17, 1911, **11**, 1087.

HUTCHINSON R. (East Chester Creek), Pelham B. Park, New York, N. Y. (S.) (Harlem River & Portchester R. R. Co.—New York, New Haven & Hartford system.) PLANS.—Rebuilding approv. July 12, 1905, **06**, 800.

HUTCHINSON R. (East Chester Creek) Boston Post Road, Borough of The Bronx, New York, N. Y. (S.) (City br.) PLANS.—Temporary and permanent br. to replace existing str. approv. Jan. 15, 1909, **09**, 917.

HYLEBOS CREEK, Lincoln Avenue, Tacoma, Wash. (S.) (Pierce County br.) PLANS.—Approv. Oct. 19, 1905, **06**, 803.

I.

ILLINOIS R. (See Ohio R.)

ILLINOIS R., Beardstown, Ill. (O.) (Chicago, Burlington & Quincy Ry. Co.) PLANS.—Alterations to be completed on or before 3 months from Mar. 8, 1904, **04,** 722.

ILLINOIS R., Beardstown, Ill. (O.) (City br.) PLANS.—Alterations to be completed on or before 3 months from Mar. 14, 1904, **04,** 722.

ILLINOIS R., Ill. (Dr.) **02,** 581.

ILLINOIS R., near Chillicothe, Ill. (O.) (Atchison, Topeka & Santa Fe Ry. Co.) PLANS.—Rebuilding approv. Jan. 7, 1903, **03,** 647. Alterations to be completed on or before 3 months from Mar. 8, 1904, **04,** 722.

ILLINOIS R., between Columbiana and Kampsville, Ill. (Sp., etc.) (Litchfield, Carrollton & Western R. R. Co.) LEGISLATION.—Company au. to constr. br. by act Mar. 3, 1883; amending act Oct. 1, 1890, **92,** 401. PLANS.—Modified plan approv. Nov. 4, 1891, and May 9, 1893, **92,** 401; **93,** 465.

ILLINOIS R., Griggsville, Ill. (O.) (Wabash R. R. Co.) PLANS.—Alterations to be completed on or before 3 months from Mar. 28, 1904 subsequently extended 3 months, **04,** 723.

ILLINOIS R., Havana, Ill. (Sp., etc.) (Chicago, Peoria & St. Louis Ry. Co.) LEGISLATION.—Company au. to constr. br. by act June 6, 1892. PLANS.—Approv. Aug. 27, 1892, **92,** 409.

ILLINOIS R., Havana, Ill. (O.) (Chicago, Peoria & St. Louis Ry. Co.) PLANS.—Alterations to be completed on or before 3 months from Mar. 12, 1904, subsequently extended to Sept. 1, 1904, **04,** 722.

ILLINOIS R., Havana, Ill. (O.) (City br.) PLANS.—Alterations to be completed on or before 3 months from Mar. 18, 1904, subsequently extended 60 days, **04,** 722.

ILLINOIS R., Havana, Ill. (O.) (Illinois Central R. R. Co.) PLANS.—Alterations to be completed on or before 3 months from Mar. 8, 1904 subsequently extended to July 15, 1904, **04,** 722.

ILLINOIS R., Henry, Ill. (O.) (Henry City Br. Co.) PLANS.—Alterations to be completed on or before 3 months from Mar. 16 1904 subsequently extended 2 months, **04,** 722.

ILLINOIS R., at the city of Lacon, Ill. (S.) (City br.) PLANS.—Approv. Dec. 24, 1909, **10,** 1026.

ILLINOIS R., near Marquette, Ill. (S.) (Streator & Clinton R. R. Co.) PLANS.—Approv. Aug. 11, 1899, **99,** 623.

ILLINOIS R., near Marquette, Ill. (O.) (Lake Shore & Michigan Southern Ry. Co.) PLANS.—Alterations to be completed on or before 3 months from Mar. 8, 1904, **04,** 722.

ILLINOIS R., Meredosia, Ill. (O.) (Wabash R. R. Co.) PLANS.—Alterations to be completed on or before 3 months from Mar. 28, 1904 subsequently extended 3 months, **04,** 722, 723.

ILLINOIS R., Ottawa, Ill. (S.) (City br.) PLANS.—Approv. Sept. 22, 1908, **09,** 915.

ILLINOIS R., near Pearl Landing, Ill. (O.) (Chicago & Alton Ry. Co.) PLANS.—Alterations to be completed on or before 3 months from Mar. 8, 1904, **04,** 722.

ILLINOIS R., Pekin, Ill. (S.) (Peoria & Pekin Traction Co.) PLANS.—Modified plans approv. Feb. 8, 1898, **98,** 534.

ILLINOIS R., Pekin, Ill. (O.) (City br.) PLANS.—Alterations to be completed on or before 3 months from Mar. 15, 1904, subsequently extended 60 days, **04,** 721.

ILLINOIS R., Pekin, Ill. (O.) (Peoria & Pekin Union Ry. Co.) PLANS.—Alterations to be completed on or before 3 months from Mar. 15, 1904, **04,** 721.

ILLINOIS R., Pekin, Ill. (O.) (Peoria & Pekin Terminal Ry. Co.) PLANS.—Alterations to be completed on or before 3 months from Mar. 15, 1904, subsequently extended to July 15, 1904, **04,** 721.

ILLINOIS R., near Pekin, Ill. (S.) (St. Louis, Peoria & Northwestern Ry. Co.) PLANS.—Approv. Aug. 8, 1911, **12,** 1300.

ILLINOIS R., Peoria, Ill. (O.) (City br., upper free wagon br.) PLANS.—Alterations to be completed on or before 3 months from Mar. 15, 1904, subsequently extended 2 months, **04,** 721.

ILLINOIS R., Peoria, Ill. (O. and S.) (City br., lower free wagon br.) PLANS.—Alterations to be completed on or before 3 months from Mar. 15, 1904, **04,** 721. Approv., **07,** 821. Reconstr. approv. Jan. 26, 1911, **11,** 1086.

ILLINOIS R., Peoria, Ill. (O.) (Toledo, Peoria & Western Ry. Co.) PLANS.—Alterations to be completed on or before 3 months from Mar. 15, 1904, subsequently extended 60 days, **04,** 721.

ILLINOIS R., Peoria, Ill. (O. and S.) (Peoria & Pekin Union Ry. Co.) PLANS.—Alterations to be completed on or before 3 months from Mar. 15, 1904, **04,** 721. Approv. Apr. 29, 1909, **09,** 918.

ILLINOIS R., Peoria, Ill. (S.) (City br.) PLANS.—For replacing br. by an entirely new str. approv. Aug. 3, 1904, **05,** 723.

ILLINOIS R., Peoria, Ill. (S.) (Peoria, Bloomington & Champaign Traction Co.) PLANS.—Approv. Mar. 23, 1906, **06**, 805.

ILLINOIS R., Peru, Ill. (A. and O.) (City br.) PLANS.—Alterations to be completed on or before 3 months from Mar. 16, 1904, subsequently extended to Sept. 1 1904, **04**, 722.

ILLINOIS R., Springvalley, Ill. (O.) (City br.) PLANS.—Alterations to be completed on or before 3 months from Mar. 16, 1904, subsequently extended to Sept. 1 1904, **04**, 722.

ILLINOIS R., Utica, Ill. (S.) (Br. of county of La Salle and towns of Deer Park and Utica, Ill.) PLANS.—Approv. Feb. 16, 1907, **07**, 825.

ILLINOIS R., near Valley City, Ill. (S.) (Wabash R. R. Co.) PLANS.—For reconstr. of existing br. approv. May 17, 1912, **12**, 1307.

ILLINOIS and MISSISSIPPI CANAL, Bureau County, Ill. (S.) (Chicago & North Western Ry. Co.) PLANS.—Approv. Oct. 9, 1901, **02**, 585. Approv. May 16, 1904, **04**, 718, 719.

INDIAN KEY. (See Florida Keys.)

INDIANA H. CANAL, at Chicago Avenue, East Chicago, Ind. (S.) (Lake County br.) PLANS.—Approv. Mar. 6, 1912, **12**, 1305.

INDIANA H. CANAL, at Canal Street, East Chicago, Ind. (S.) (Lake County br.) PLANS.—Approv. Mar. 7, 1912, **12**, 1305.

INDIAN R., at Jupiter Narrows, half m. north of Hobe, Fla. (Palm Beach County br.) PLANS.—Approv. Feb. 15, 1911. **11**, 1087.

INDIAN R., Mich. (S.) (Jackson, Lansing & Saginaw R. R. Co.—Michigan Central R. R.) PLANS.—Rebuilding approv. Jan. 30, 1903, **03**, 648.

INGRAMS THOROUGHFARE, N. J. (See Leonards Thoroughfare.)

INGRAMS THOROUGHFARE, N. J. (S.) (Cape May County br.) PLANS.—Approv. Mar. 4, 1912, **12**, 1305.

INLAND WATERWAYS. (See Christiana R. Wilmington, Del., etc.)

J.

JAMAICA B., beach chan., Rockaway Beach, N. Y. (S.) (Brooklyn & Jamaica Bay Turnpike Co.) PLANS.—Approv. Dec. 21, 1898, **99,** 621.

JAMAICA B., N. Y. (S.) (Brooklyn & Jamaica Bay Turnpike Co.) PLANS.—Modifications in orig. plans (Dec. 21, 1898) approv. Oct. 26, 1900, **01,** 663.

JAMES R., Richmond, Va. (S.) (Richmond, Petersburg & Carolina R. R. Co.) PLANS.—Approv. July 28, 1899, **99,** 623.

JARNIGAN SLOUGH, Cal. (S.) (Eureka & Fresh Water Ry. Co.) PLANS.—Approv. Mar. 26, 1902, **02,** 587, 588.

JEW FISH CREEK. (See Florida Keys.) .

JOHN DAY R., Oreg. (Dr.) **02,** 581.

JOHN DAY R., Oreg. (S.) (Astoria & Columbia River R. R. Co.) PLANS.—Approv. Nov. 18, 1895, **96,** 425.

JOHNS R. (See Chehalis R.)

JOHNS R., Chehalis County (sec. 2, T. 16 N., R. 11 W., Willamette meridian), Wash. (S.) PLANS.—Approv. Oct. 5, 1910, **11,** 1063.

JOHNSON CREEK. (See Albemarle Sound.)

JONES, or **WELSHMANS, CREEK, N. PT. CREEK,** and **SHALLOW CREEK,** Md. (S.) (Baltimore, Sparrows Point & Chesapeake Ry. Co.) PLANS.—Approv. Dec. 20, 1904, **05,** 725.

JUPITER NARROWS, Fla. (See Indian R.)

JUPITER R., Fla. (Dr.) **03,** 642.

JUPITER R., Fla. (S.) (Jacksonville, St. Augustine & Indian River Ry. Co.) PLANS.—Approv. Aug. 15, 1893, **93,** 471.

K.

KABEKONA NARROWS, Minn. (S.) (St. Paul, Minneapolis & Manitoba Ry. Co.) PLANS.—Approv. Mar. 14, 1898, **98,** 534.

KALAMAZOO R., Allegan, Mich. (S.) (Pere Marquette R. R. Co.) PLANS.—Approv. Oct. 1, 1901, **02,** 585. Reconstr. approv. Mar. 23, 1908, **08,** 872.

KALAMAZOO R., Mich. (Dr.) **09,** 912.

KALAMAZOO R., New Richmond, Mich. (A. and O.) (Chicago & West Michigan Ry. Co.) PLANS.—Approv. June 13, 1899, for a 40′ draw over main chan. before Aug. 26, 1899. On July 31, 1899, previous action modified, at option of company, as specified. **99,** 624. Company failed to alter br. within time specified. Alteration plans as required by the department accepted Mar. 13, 1900, as satisfactory. Time extended to July 15, 1902. **00,** 702.

KANAWHA R. (See Ohio R.)

KANAWHA R., Charleston, W. Va. (Sp.) (Kanawha Br. & Terminal Co.) Au. act Mar. 3, 1887. PLANS.—Approv. Apr. 5, 1907, **07,** 819.

KANAWHA (Little) **R.,** Main Street, Glenville, W. Va. (S.) (Gilmer County br.) PLANS.—Approv. Aug. 23, 1910, **11,** 1083.

KANAWHA R., Montgomery, W. Va. (S.) (Penn Br. Co.) PLANS.—Approv. July 25, 1905, **06,** 801.

KANAWHA R., Montgomery, W. Va. (S.) (Montgomery Br. Co.) PLANS.—Approv. Sept. 5, 1907, **08,** 869. Map of new location approv. Sept. 8, 1908; new approv. in name of Montgomery & Cannelton Br. Co., and former approv. canceled Feb. 16, 1909, **09,** 915.

KANAWHA R., at Montgomery and Cannelton, W. Va. (S.) (Montgomery Br. Co.) PLANS.—Approv. Sept. 8, 1908; supple. plans approv. Feb. 16, 1909, and plans for false work approv. Nov. 13, 1909, **10,** 1025.

KANSAS R., Kansas City, Kans. (S.) (Chicago, Rock Island & Pacific Ry. Co.) PLANS.—Rebuilding approv, Apr. 14, 1905, **05,** 726.

KANSAS R., Kansas City, Kans. (S.) (Kansas City Viaduct & Terminal Ry. Co.) PLANS.—Approv. June 1, 1905, **05,** 727.

KAW (Kansas) **R.,** Kansas City, Kans. (S.) (Kansas City Belt Ry. Co.) PLANS.—Reconstr. approv. Sept. 19, 1905; approv. amended by instrument dated Dec. 2, 1905, and modified plans approv. Jan. 11, 1907, **06,** 803; **07,** 824.

KANSAS R., Kansas City, Kans. (S.) (Missouri Pacific Ry. Co.) PLANS.—New br. to replace existing br. approv. Dec. 31, 1909, **10,** 1026. Reconstr. approv. July 18, 1911, **11,** 1299.

KANSAS R., Kansas City, Kans. (S.) (Union Pacific R. R. Co.) PLANS.—Rebuilding approv. Jan. 7, 1909, **09,** 916. Reconstr. approv. May 28, 1910, **10,** 1030.

KANSAS R., Kansas City, Kans. (1,300′ above mouth). (Sp.) (Edgewater Connecting Ry. Co.) Au. act Feb. 6, 1909, and Feb. 3, 1910. PLANS.—Approv. Jan. 30, 1911, **11,** 1080.

KANSAS R., James Street, Kansas City, Kans. (S.) (Wyandotte County br.) PLANS.—Reconstr. plans approv. May 12, 1911, **11,** 1089.

KANSAS R., West Kansas Avenue, Kansas City, Kans. (S.) (Wyandotte County br.) PLANS.—Reconstr. of existing br. approv. Mar. 4, 1912, **12,** 1305.

KANSAS R., Topeka Kans. (S.) (Topeka Ry. Co.) PLANS.—Rebuilding approv. Nov. 4 1904, **05,** 724.

KASKASKIA (Okaw) **R.,** near Baldwin, Ill. (S.) (Mobile & Ohio R. R. Co.) PLANS.—Rebuilding approv. May 17, 1906, **06,** 807.

KASKASKIA R., near Missouri Junction, Ill. (S.) (St. Louis & Southern Illinois Ry. Co.) PLANS.—Approv. June 14, 1901, **01,** 667.

KASKASKIA R., Randolph County, Ill. (S.) (St. Louis Valley Ry.) PLANS.—Approv. Aug. 5, 1901, **02,** 583.

KAWKAWLIN R., Bay County, Mich. (S.) (Detroit & Mackinac Ry. Co.) PLANS.—Approv. June 29, 1896, **96,** 427.

KENDUSKEAG R., Bangor, Me. (S.) (Maine Central R. R. Co., lessee of European & North America Ry.) PLANS.—Reconstr. approv. May 25, 1905, **05,** 727.

KENNEBEC R. (See Atkins B.)

KENT ISLD. NARROWS, Md. (S.) (Queen Anne County br.) PLANS.—Approv. June 22, 1904, **04,** 719.

KENT ISLD. NARROWS, Kent Isld., Md. (S.) (Queen Annes R. R. Co.) PLANS.—Approv. Mar. 13, 1901, **01,** 665.

KENT ISLD. NARROWS, Md. (Dr.) **02,** 581; **07,** 815.

KENT NARROWS, Md. (S.) (Maryland, Delaware & Virginia Co.) PLANS.—Reconstr. of existing br. approv. Sept. 12, 1911, **12,** 1301.

KENTUCKY R., Ky. (A.) **88,** 2574. LEGISLATION.—Notice served as to alterations required, **90,** 342. PLANS.—Location and dimensions of brs. crossing the imp. portion of the Kentucky R., **88**, 2574. Br. at Worthville and 2 at Frankfort restrict navigation, and Capt. Post recom. that they be raised or rebuilt, **88**, 2575, 2576.

KENTUCKY R., Carrollton, Ky. (S.) (Carrollton & Prestonville Br. Co.) PLANS.—Approv. Nov. 10, 1899, **00**, 699. Former approv. of plans of Carrollton Electric Co., Nov. 10, 1899, canceled. Rights transferred to Carrollton & Prestonville Br. Co., and plans approv. in latter name July 25, 1900, **01**, 662.

KENTUCKY R., Ford, Ky. (S.) (Louisville & Nashville R. R. Co.) PLANS.—Rebuilding approv. Apr. 14, 1906, **06**, 806.

KENTUCKY R., Frankfort, Ky. (O.) (Louisville & Nashville R. R. Co.) PLANS.—Alterations required by Jan. 1, 1890; time extended to Jan. 9, 1891, **89**, 376. Required to raise br. 10', on or before Sept. 1, 1892, **91**, 436. Plans for raising br. 43' 4" in all, required under act Sept. 19, 1890; approv. Oct. 24, 1892, **93**, 471.

KENTUCKY R., Ky. (S.) (City of Frankfort and County of Franklin br.) PLANS.—Under act Sept. 19, 1890, raising of br. to 48' 4" above normal pool level au. Sept. 8, 1891, **92**, 411. Plans for elevating br. 43' 4" approv. May 22 1893, **93**, 473.

KENTUCKY R., St. Clair Street, Frankfort, Ky. (O.) (Frankfort County br.) PLANS.—Specified alterations to be made on or before Sept. 1, 1892, **92**, 411.

KENTUCKY R., St. Clair Street, Frankfort, Ky. (O.) (City br.) PLANS.—Alterations required by Jan. 1, 1890; time extended to Jan. 1, 1891, **89**, 376.

KENTUCKY R., near Irvine, Ky. (S.) (Irvine Fall Br. Co.) PLANS.—Approv. Sept. 17, 1909, **10**, 1024.

KENTUCKY R., near mouth of Sturgeon Creek, Ky. (S.) (Louisville & Atlantic R. R. Co. PLANS.—Approv. Apr. 7, 1906, **06**, 805.

KENTUCKY R., near Tyrone, Ky. (Sp.) (Louisville Southern Ry. Co.) LEGISLATION.—Company au. to constr. br. by act Oct. 9, 1888, **89**, 371. PLANS.—Approv. Mar. 30, 1889, **89**, 371.

KENTUCKY R., Worthville, Ky. (O.) (Louisville & Nashville R. R. Co.) PLANS.—Alterations required by Jan. 1, 1890; time extended to Jan. 9, 1891, **89**, 376.

KENTUCKY R., N. Fork. (S.) (Ohio & Kentucky Ry. Co.) PLANS.—Approv. Oct. 27, 1899, **00**, 699.

KENTUCKY R. (N. Fork), below Jackson, Ky. (S.) (Kentucky Lumber & Veneer Co.) PLANS.—Approv. June 5, 1902, **02**, 589. Modified plans for changes in substr. approv. July 25, 1903, **03**, 645.

KENTUCKY R. (N. Fork), Breathitt County, Ky. (S.) (Kentucky R. Hardwood Co.) PLANS.—Approv. May 9, 1910, **10**, 1030.

KENTUCKY R., N. Fork, mouth of Walkers Creek, Ky. (Sp.) (Kentucky Union Ry. Co.) LEGISLATION.—Company au. to constr. br. by act Mar. 1, 1889. PLANS.—Approv. June 19, 1889, **89**, 372.

KENTUCKY R. (N. Fork), Ky. (S.) (Lexington & Eastern Ry. Co.—Crossing No. 2.) PLANS.—Approv. Jan. 25, 1911, **11**, 1085.

KENTUCKY R. (N. Fork), Ky. (S.) (Lexington & Eastern Ry. Co.—Crossing No. 3.) PLANS.—Approv. Jan. 26, 1911, **11**, 1086.

KENTUCKY R. (N. Fork), Ky. (S.) (Lexington & Eastern Ry. Co.—Crossing No. 4.) PLANS.—Approv. Jan. 26, 1911, **11**, 1086.

KENTUCKY R. (N. Fork), Ky. (S.) (Lexington & Eastern Ry. Co.—Crossing No. 5.) PLANS.—Approv. Jan. 25, 1911, **11**, 1085.

KENTUCKY R. (N. Fork), Ky. (S.) (Lexington & Eastern Ry. Co.—Crossing No. 6.) PLANS.—Approv. Jan. 25, 1911, **11**, 1085.

KENTUCKY R. (N. Fork), Ky. (S.) (Lexington & Eastern Ry. Co.—Crossing No. 7.) PLANS.—Approv. Jan. 25, 1911, **11**, 1085.

KENTUCKY R. (N. Fork), Ky. (S.) (Lexington & Eastern Ry. Co.—Crossing No. 8.) PLANS.—Approv. Jan. 25, 1911, **11**, 1085.

KENTUCKY R. (N. and S. Forks), Beattyville, Ky. (S.) (Brs. of George I. Hammond et al.) PLANS.—Approv. Aug. 29, 1906, **07**, 821.

KEWAUNEE R., Kewaunee, Wis. (Sp., etc.) (Kewaunee, Green Bay & Western R. R. Co.) LEGISLATION.—Company au. to constr. br. under act July 13, 1892, and act of Wisconsin. PLANS.—Approv. Sept. 6, 1892, **92**, 410.

KEWAUNEE R., Park Street, Kewaunee, Wis. (S.) (City br.) PLANS.—Submitted July 2, 1892, for replacing old with new br.; approv. Oct. 14, 1892, **93**, 466. Approv. May 19, 1905, **05**, 727.

KEY WEST. (See Florida Keys.)

KIAMICHI R., ½ m. sw. of Roby or Sawyer Okla. (Choctaw County br.) PLANS.—Approv Jan. 20, 1912, **12**, 1304.

KIAMICHI R., 4 m. s. of Port Townsend, Choctaw County, Okla. (S.) (County br.) PLANS.—Approv. Jan. 25, 1912, **12**, 1304, 1305.

KICKEMUIT R., Warren, R. I. (S.) (New York, New Haven & Hartford R. R. Co.) PLANS.—Reconstr. plans approv. Apr. 7, 1911, **11**, 1088.

KINGSLEYS CREEK, Fla. (O.) (County br.) PLANS.—Narrow opening of the county br., near the R. R. br., dangerous to S. S., **89**, 2797.

KINGSLEYS CREEK, a part of the inland communication between Savannah, Ga., and Jacksonville, Fla. (O.) (Florida Ry. & Navigation Co.) PLANS.—Alterations required by Apr. 15, 1889; time extended to May 1, 1889. Br. provided with a 56.7' draw span, which is sufficient. **89**, 377.

KINNICKINNICK R., Milwaukee, Wis. (S.) (Chicago & North Western Ry. Co.) PLANS.—Reconstr. plans and plans for a temporary br. approv. Jan. 13, 1897, **97**, 533.

KINNICKINNICK R., Clinton Street, Milwaukee, Wis. (S., Sp., etc.) (City br.) LEGISLATION.—City au. to constr. br. under act July 13, 1892, sec. 3, and act of Wisconsin. PLANS.—For new br. approv. Sept. 12, 1892, **92**, 410. Modified plans approv. July 29 1893, **93**, 470.

KINNICKINNICK R., Lincoln Avenue, Milwaukee, Wis. (S.) (City br.) PLANS.—For temporary br., for use pending reconstr. of existing br., approv. Nov. 1, 1898. Modified plans. change in location to permit constr. of br. at Lincoln Avenue, approv. Dec. 31, 1898. **99**, 621. Reconstr. plans approv. Sept. 21, 1899, **00**, 699.

KINNICKINNICK R., Kinnickinnick Avenue Milwaukee, Wis. (S.) (City br.) PLANS.—Rebuilding approv. Sept. 17, 1907 **08**, 870.

KINNICKINNICK R., near Kinnickinnick Avenue, Milwaukee, Wis. (S.) (Chicago & North Western Ry. Co.) (See above.) PLANS.—Rebuilding approv. Sept. 17, 1907, **08**, 870.

KINNICKINNICK R., near Kinnickinnick Avenue, Milwaukee, Wis. (S.) (Chicago, Milwaukee & St. Paul Ry. Co.) PLANS.—Br. to replace existing str. approv. Sept. 17, 1907, **08**, 870.

KLICKITAT R., Wash. (S.) (Portland & Seattle Ry. Co.) PLANS.—Approv. Feb. 9, 1907. **07**, 826.

KOOTENAI R., Bonners Ferry, Idaho. (Sp.) (International Ry. Co.) PLANS.—Approv. Oct. 19, 1905, **06**, 799.

KOOTENAI R., Bonners Ferry, Idaho. (Sp.) (Bonners Ferry Bridge Commission.) Au. act Feb. 3, 1910. PLANS.—Approv. Feb. 18, 1910 **10**, 1021.

KOOTENAI R., Bonners Ferry, Idaho. (Sp.) (Kootenai Valley Ry. Co.) Au. act June 25, 1910. PLANS.—Approv. Sept. 13, 1910, **11**, 1079.

KOOTENAI R., near Libby Mont. (Sp.) (Lincoln County br.) Au. act Mar. 4, 1912. PLANS.—Approv. Mar. 15, 1912 **12**, 1297.

KOOTENAI R., near Rexford, Mont. (Sp.) (Lincoln County br.) Au. act Mar. 4, 1912. PLANS.—Approv. Mar. 15, 1912, **12**, 1297.

KOOTENAI R., near Troy, Mont. (Sp.) (Lincoln County br.) Au. act Mar. 4, 1912. PLANS.—Approv. Mar. 15, 1912, **12**, 1297.

L.

LACASSINE BAYOU, La. (S.) (Louisiana Western R. R. Co.) PLANS.—Approv. Sept. 25, 1903, **04,** 714.

LACOMBE BAYOU, St. Tammany Parish, La. (S.) (New Orleans Great Northern R. R. Co.) PLANS.—Approv. Sept. 10, 1907, **08,** 870.

LAFOURCHE BAYOU, La. (S.) (Morgan's Louisiana & Texas R. R. & S. S. Co.) PLANS.—Reconstr. plans approv. July 29, 1899, **99,** 623.

LAFOURCHE BAYOU, Donaldsonville, La. (S.) (Lemann Co., Ltd.) PLANS.—Approv. May 10, 1905, **05,** 727.

LAFOURCHE BAYOU, Labadieville, La. (S.) (Labadieville Br. Co.) PLANS.—Approv. June 2, 1893, **93,** 470.

LAFOURCHE BAYOU, Labadieville, La. (S.) (Eugene Constantin, Jules Bragard, and Louis Coddon.) PLANS.—Approv. May 23, 1906, **06,** 807.

LAFOURCHE BAYOU, Laurel Grove Plantation, near Thibodeaux, La. (S.) (Trosclair & Robichaux Co., Ltd.) PLANS.—Approv. Apr. 20, 1906, **06,** 806.

LAFOURCHE BAYOU, Lockport, La. (S.) (Lockport Br. Stock Co.) PLANS.—Approv. June 30, 1899, **99,** 623.

LAFOURCHE BAYOU, Napoleonville, La. (S). (Napoleonville Br. Stock Co.) PLANS.—Approv. June 5, 1893, **93,** 470.

LAFOURCHE BAYOU, Napoleonville, La. (S.) (Leon Godchaux Co., Ltd.) PLANS.—Approv. July 6, 1905, **06,** 800.

LAFOURCHE BAYOU, Plattenville, La. (S.) (Baker-Wakefield Cypress Co.) PLANS.—Approv. Nov. 9, 1911, **12,** 1302.

LAFOURCHE BAYOU, Raceland, La. (S.) (Br. of M. J. Theroit, of Lafourche Crossing.) PLANS.—Approv. Oct. 18, 1911, **12,** 1302.

LAKE BIJEAU, La. (S.) (Morgan's Louisiana & Texas R. R. & S. S. Co.) PLANS.—Approv. May 25, 1906, **06,** 807.

LAKE BIJEAU, St. Martin Parish, La. (S.) (Morgan's Louisiana & Texas R. R. & S. S. Co.) PLANS.—Approv. Aug. 16, 1906, **07,** 821.

LAKE CHAMPLAIN, between Colchester and South Hero, Vt.; Grand Isle and North Hero, Vt.; and North Hero and Albany, Vt. (Sp.) (Rutland-Canadian R. R. Co.) LEGISLATION.—Company au. to constr. these brs. by act Feb. 4, 1899. PLANS.—Approv. Mar. 16, 1899, **99,** 619.

LAKE CHAMPLAIN, between North Hero and Alburg. (Sp.) **88,** 398, 2432. LEGISLATION.—Br. au. by act June 20, 1884, **88,** 2431. PLANS.—Maj. Adams reported br. not an obstr. to navigation, **88,** 2432-2433.

LAKE CHAMPLAIN, Rouse Pt., N. Y. (Sp.) LEGISLATION.—Br. au. act Feb. 24, 1883, **83,** 271. PLANS.—Chief of Engineers recom. plans and location of the br. be approv., **83,** 1611.

LAKE CHAMPLAIN, at Rouse Pt., between Alburg, Vt., and Champlain, N. Y. (Sp.) (Rutland-Canadian R. R. Co.) LEGISLATION.—Company au. to constr. br. act Feb. 4, 1899. PLANS.—Approv. Feb. 10, 1900, **00,** 697.

LAKE CHAMPLAIN CHAN., North Hero, Vt. (Sp.) LEGISLATION.—Au. act Oct. 12, 1888. PLANS.—Submitted and approv. July 2, 1889, **90,** 336.

LAKE CHAMPLAIN, chan. known as "The Gut," between Tromps, South Hero Isld., and Bow Arrow Pt., North Hero Isld., Vt. (O.) (Rutland R. R. Co.) PLANS.—Alternative alterations to be completed on or before Dec. 31, 1907, or within 4 months from Aug. 17, 1906, respectively, **07,** 828.

LAKE CHARLES, Ga. (See Calcasieu R.)

LAKES DITCH and BEACH THOROUGHFARE, Atlantic City, Atlantic County, N. J. (on line of new highway from Pleasantville to Atlantic City). (S.) (Atlantic County brs.) PLANS.—Approv. Feb. 3, 1903, **03,** 648, 649.

LAKES DORA and EUSTIS (waterway connecting), Fla. (O.) (Lake County br.) PLANS.—Alterations to be completed on or before Sept. 1, 1906, **06,** 809.

LAKES DORA and EUSTIS (waterway connecting), Fla. (O.) (Seaboard Air Line Ry. Co.) PLANS.—Alterations to be completed on or before Sept. 1, 1906, **06,** 809.

LAKES DORA and EUSTIS (waterway connecting), Fla. (O.) (Atlantic Coast Line Ry. Co.) PLANS.—Alterations to be completed on or before Sept. 1, 1906, **06,** 809.

LAKE ERIE. (See Detroit, Mich.)

LAKE HARNEY, Fla. (See St. Johns R.)

LAKE HURON. (See Detroit, Mich.)

LAKE PEND OREILLE, Kootenai County Idaho. (S.) (Northern Pacific Ry. Co.) PLANS.—Approv. Oct. 10, 1902 **03,** 646.

LAKE PONTCHARTRAIN, La. (Dr.) **05,** 719.

LAKE PONTCHARTRAIN, La. (S.) (New Orleans & Northeastern R. R. Co.) PLANS.—For rebuilding approv. Mar. 15, 1906, **06,** 805.

LAKE R., near Ridgefield, Wash. (S.) (Oregon & Washington R. R. Co.) PLANS.—Approv. May 3, 1907, **07,** 827. Grantee decided not to constr. br. and approv. was revoked by instrument dated Nov. 22, 1910, **11,** 1084.

LAKE ST. CROIX, Hudson City, Wis. (Sp. and A.) (Railway.) LEGISLATION.—Br. au. act May 15, 1872, **78,** 1091. PLANS.—Maj. Allen reported that sheer booms should be placed to assist vessels in passing the spans, **88,** 2637.

LAKE UNION (e. arm), Hester Avenue, Seattle, Wash. (S.) (City br.) PLANS.—Rebuilding approv. May 29, 1902, **02,** 589.

LAKE UNION, Seattle, Wash. (S.) (Seattle Electric Co.) PLANS.—Approv. Sept. 6, 1901, **02,** 585. Temporary str. approv. Nov. 17, 1908; change of location approv. Jan. 15, 1909, **09,** 916.

LAKE UNION, at waterway No. 14 and East Lake Avenue, Seattle, Wash. (S.) (City br.) PLANS.—Temporary trestle approv. Mar. 15, 1910, **10,** 1028.

LAKE UNION, at West Lake Avenue and Stone Way, Seattle, Wash. (City br.) PLANS.—Temporary trestle br. approv. Oct. 6, 1910, **11,** 1084.

LAKE UNION, Wash. (See Puget Sound and Lakes Union and Washington.)

LAKE UNION and **LAKE WASHINGTON** (portage between), Seattle, Wash. (S.) (City br.) PLANS.—Approv. Feb. 12, 1908, **08,** 871.

LAKE UNION and **LAKE WASHINGTON** (portage between), Seattle, Wash. (S.) (Seattle Electric Co.) PLANS.—Approv. Aug. 17, 1908, **09,** 914.

LAKE UNION and **LAKE WASHINGTON,** Wash. (br. over right of way for a canal between). (S.) (Br. of city of Seattle.) PLANS.—Temporary br. approv. Jan. 20, 1910, **10,** 1026.

LAKE WASHINGTON, Wash. (See Puget Sound and Lakes Union and Washington.)

LAKE WASHINGTON SHIP CANAL, Seattle, Wash. (S.) (City br.) PLANS.—Approv. Apr. 29, 1902, **02,** 588.

LAKE WASHINGTON CANAL, Seattle, Wash. (S.) (Northern Pacific Ry. Co.) PLANS.—Approv. Aug. 5, 1902, **03,** 645.

LAKE WASHINGTON and **PUGET SOUND CANAL,** at 13th Avenue West, Seattle, Wash. (S.) (Seattle Electric Co.) PLANS.—Approv. Apr. 5, 1910, **10,** 1029.

LAKE WORTH CHAN., Fla. (Dr.) **03,** 642.

LAKE WORTH, Palm Beach, Fla. (S.) (Florida East Coast Ry. Co.) PLANS.—Approv. June 14, 1901, **01,** 667.

LAKE WORTH, between Palm Beach and W. Palm Beach, Fla. (S.) (Palm Beach Imp. Co.) PLANS.—Approv. July 20, 1910, **11,** 1082.

LARRABEE SLOUGH. (See Nooksak R.)

LAVACA R., near Texana and mouth of Navadad R., Tex. (S.) (St. Louis, Brownsville & Mexico Ry. Co.) PLANS.—Approv. Apr. 15, 1905, **05,** 727.

LAZARETTO CREEK, Ga. (A.) (Savannah & Tybee R. R. Co.) PLANS.—Very little C.; difficult to pass through the draw without striking the ps., **89,** 2796.

LAZARETTO CREEK, Ga. (Dr.) **06,** 797.

LEAF R., near Atkinsons Creek or Cochrans Ferry, Miss. (S.) (Green County br.) PLANS.—Approv. Apr. 25, 1902, **02,** 588.

LEAF R., near Beaumont, Miss. (S.) (Mobile Jackson & Kansas City R. R. Co.) PLANS.—Approv. Aug. 17, 1903, **04,** 714.

LEAF R., near Beaumont, Miss. (S.) (Perry County br.) PLANS.—Approv. Jan. 16, 1907, **07,** 824.

LEECH LAKE R., Minn. (S.) (Minneapolis, St. Paul & Sault Ste Marie Ry. Co.) PLANS.—Approv. Apr. 21, 1910, **10,** 1029.

LEES R., between Swansea and Somerset, Mass. (S.) (Old Colony R. R. Co., New York, New Haven & Hartford R. R. Co., lessee.) PLANS.—Reconstr. approv. June 12, 1911, **11,** 1090.

LEIPSIC R., Leipsic, Del. (O.) (Kent County br.) PLANS.—Alterations to be completed on or before Sept. 1, 1909, **09,** 919.

LEIPSIC R., Kent County, Del. (O.) (Kent County br.—Martins br.) PLANS.—Alterations to be completed on or before Oct. 1, 1909, **09,** 920.

LEONARDS, INGRAMS, and **CRAVEN THOROUGHFARES, ELDER CREEK** and **AMOS CREEK,** N. J. (Brs. of Avalon Boulevard Co.) PLANS.—6 brs. approv. Nov. 30, 1910, **11,** 1085.

LEONARDS THOROUGHFARE, N. J. (S.) (Cape May County br.) PLANS.—Approv. Mar. 4, 1912, **12,** 1305.

LEVISA FORK. (See Big Sandy R.)

LEWES CREEK, Lewes, Del. (S.) (Queen Anne R. R. Co.) PLANS.—Approv. Mar. 30, 1898, **98,** 535. Modified plans approv. Oct. 12, 1910, **11,** 1084.

LEWIS AND CLARK R., Clatsop County, Oreg. (S.) (Clatsop County br.) PLANS.—Approv. Mar. 25, 1903, **03,** 649.

LEWIS AND CLARK R., Oreg. (S.) (Clatsop County br.) PLANS.—Approv. Mar. 30, 1896, **96,** 426.

LEWIS AND CLARK R. Oreg. (Dr.) **02,** 581; **04,** 710.

LEWIS GUT, Bridgeport H., Conn. (S.) (Bridgeport Steeplechase Co.) PLANS.—Approv. Apr. 16, 1908, **08,** 872.

LEWIS R., Wash. (S.) (Washington & Oregon Ry. Co.) PLANS.—Approv. Sept. 28, 1901, **02,** 585.

LEWIS R., La Center, Wash. (S.) (Clark County br.) PLANS.—Reconstr. approv. July 3, 1900, **01,** 661.

LEWIS R., near Woodland, Wash. (S.) (Oregon & Washington R. R. Co.) PLANS.—Approv. May 4, 1907, **07,** 827. Approv. revoked by instrument dated Nov. 25, 1910, it appearing that grantee did not intend to constr. br., **11**, 1084.

LEWIS R., E. Fork, La Center, Wash. (S.) (Clark County br.) PLANS.—Approv. Apr. 11, 1894, **94**, 428.

LEWIS R., N. Fork, at Woodland, Wash. (S.) (State br.) PLANS.—Approv. Jan. 8, 1912, **12**, 1304.

LEWIS R., Wash. (Dr.) **10**, 1019.

LEXAHATCHEE (Jupiter) **R.**, near West Jupiter, Fla. (S.) (Palm Beach County br.) PLANS.—Approv. July 20, 1910, **11**, 1082.

LICKING R., Farmers, Ky. (S.) (Bath-Rowan Br. Co.) PLANS.—Approv. Sept. 1, 1908, **09**, 915.

LICKING R., between Newport and Covington, Ky. (Sp., etc.) (Kenton and Campbell Counties br.) LEGISLATION.—Counties au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Kentucky. PLANS.—Approv. Apr. 20, 1892. Plans for false work, to be erected during constr., approv. Aug. 10, 1892; false work and all obstr. to be removed by Oct. 1, 1892. **92**, 404.

LITTLE B. (Main Thorofare) N. J. (S.) (Cape May County br.) PLANS.—Approv. Mar. 5, 1912, **12**, 1305.

LITTLE CALUMET R., near Chicago, Ill. (S.) (Michigan Central R. R. Co.) **98**, 536. PLANS.—Reconstr. plans approv. June 16, 1898.

LITTLE CALUMET R., near Chicago, Ill. (S.) (Calumet Western Ry. Co.) PLANS.—Approv. May 2, 1899, **99**, 622.

LITTLE CHUTE, U. S. canal at lock, Wis. (S.) (Kaukauna br.) PLANS.—Approv. June 22, 1894, **91**, 429.

LITTLE FORK R., near Little Fork, Minn. (S.) (Big Fork & International Falls Ry. Co.) PLANS.—Approv. Apr. 16, 1907, **07**, 826.

LITTLE HELL GATE. (See East R.)

LITTLE HOQUIAM R., at Hoquiam, Wash. (S.) (City br.) PLANS.—Reconstr. an existing br. approv. Feb. 23, 1910, **10**, 1027.

LITTLE ISLAND, chan. separating it from mainland at Osterville, in town of Barnstable, Mass. (Sp.) (Messrs. F. W. Dickinson, R. M. Winfield, F. P. Foster, and J. H. Murphy.) LEGISLATION.—Owners au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Massachusetts. PLANS.—Approv. May 19, 1891, **91**, 431.

LITTLE KANAWHA R. (See Ohio R., etc.)

LITTLE KANAWHA R., Braxton County, W. Va. (S.) (Coal & Coke Ry. Co.) PLANS.—Plans in lieu of those approv. May 1, 1903, for a br. to be built by the Little Kanawha R. R. Co., were approv. July 29, 1904, **05**, 723.

LITTLE KANAWHA R., Burnsville, W. Va. (S.) (Baltimore & Ohio R. R. Co.) PLANS.—Reconstr. approv. June 27 1906, **06**, 808.

LITTLE KANAWHA R., Burnsville, W. Va. (S.) (Town br.) PLANS.—Approv. June 23, 1906, **06**, 808.

LITTLE KANAWHA R., at Gilmer Station, W. Va. (S.) (County br.) PLANS.—Approv. June 7, 1910, **10**, 1030.

LITTLE KANAWHA R., Grantsville (Graniteville), W. Va. (S.) (Calhoun County br.) PLANS.—Approv. Oct. 27, 1909, **10**, 1025. Approv. Oct. 22, 1909, and Mar. 10, 1910. Modified plans approv. Apr. 3, 1912, **12**, 1306, 1307. New plans approv. June 21, 1912, and instrument dated Apr. 3, 1912, canceled, **12**, 1308.

LITTLE KANAWHA R. Hyers Run, Braxton County, W. Va. (S.) (Braxton County br.) PLANS.—Approv. Feb. 21, 1903, **03**, 649.

LITTLE KANAWHA R., Parkersburg, W. Va. (A.) (County, etc.) PLANS.—Description, **88**, 2577. Capt. Post recom. it be converted into a drawbr. by building a middle p., **88**, 2577. Br. destroys a former landing of Ohio R. steamers, and prevents the use of the mouth of the R. as an ice h., **88**, 2649.

LITTLE KANAWHA R., Parkersburg, W. Va. (S.) (Parkersburg & South Side Br. Co.) PLANS.—Approv. Mar. 15, 1907, **07**, 826.

LITTLE KANAWHA R., Wirt, Calhoun, Gilmer, and Braxton Counties, W. Va. (S.) (Little Kanawha R. R. Co.) PLANS.—Of 7 brs. over this stream approv. May 1, 1903, **03**, 650.

LITTLE POTTSBURG CREEK, Duvall County, Fla. (S.) (Duvall County br.) PLANS.—To replace existing br. approv. Jan. 29, 1910, **10**, 1027.

LITTLE RED R., Ark. (Dr.) **07**, 815.

LITTLE RED R., Pangburn, Ark. (S.) (Harry Churchill.) PLANS.—Approv. May 22, 1909, **09**, 918.

LITTLE R., Ark. (Dr.) **07**, 815.

LITTLE R., Ark. (S.) (Jonesboro, Lake City & Eastern Ry. Co.) PLANS.—Rebuilding approv. July 12, 1905, **06**, 801.

LITTLE R., in Catahoula Parish, La. (S.) (Louisiana & Arkansas Ry. Co.) PLANS.—Approv. Sept. 19, 1911, **12**, 1301.

LITTLE R., La. (Sp.) (Houston, Central Arkansas & Northern R. R. Co.) LEGISLATION.—Company au. to constr. br. by act Aug. 6, 1888: amending act Aug. 18, 1890, **91**, 429. PLANS.—Approv. Nov. 5, 1890. Navigation interests require a drawbr.; new plans for same approv. June 15, 1891. **91**, 429.

LITTLE R., near Morris Ferry, Ark. (Sp.) (Texarkana & Fort Smith Ry. Co.) LEGISLATION.—Company au. to constr. br. by act Apr. 21, 1894; amending act Jan. 19, 1895. PLANS.—Approv. Mar. 27, 1895, on certain conditions respecting height above water, **95**, 475.

LITTLE R. (near Whitecliffs), Ark. (S.) (Kansas City Southern Ry. Co.) PLANS.—Approv. Oct. 10, 1902, **03**, 646. Plans in lieu thereof approv. June 15, 1906, **06**, 808.

LITTLE R., between Grant and Catahoula Parishes, near Simmons Ferry, La. (S.) (Louisiana & Arkansas R. R. Co.) PLANS.—Approv. May 9, 1903, **03**, 650.

LITTLE R., Jonesville, La. (S.) (Catahoula Parish br.) PLANS.—Rebuilding approv. May 29, 1909, **09**, 918.

LITTLE R., between Jonesville and Trinity, La. (S.) (Catahoula Parish br.) PLANS.—Approv. June 1, 1904, **04**, 719.

LITTLE R., Lodie Ferry, Ark. (S.) (St. Louis, San Francisco & New Orleans R. R. Co.) PLANS.—Br. to replace existing str. approv. May 31, 1904, **04**, 719.

LITTLE R., Lynn, Mass. (S.) (City br.) PLANS.—Approv. Aug. 1, 1907, **08**, 868.

LITTLE R., near Middletown, Conn. (S.) (New York, New Haven & Hartford R. R. Co.) PLANS.—Reconstr. plans approv. July 9, 1910, **11**, 1082.

LITTLE R., Perry, Washington County, Me. (O.) (City br.) PLANS.—Alterations required: A draw with 16′ width of opening in the chan. span of the br. to be completed within 3 months from Oct. 15, 1895; time extended frequently, last extension being to Sept. 1, 1896, **96**, 427.

LITTLE R., near Whitecliffs (Folmina), Ark. (S.) (Memphis, Paris & Gulf R. R. Co.) PLANS.—Approv. May 9, 1907, **07**, 827.

LITTLE SHOALS R., Minn. (See Big Fork R.)

LITTLE ST. MARKS R., Fla. (See St. Marks R., Fla.)

LITTLE SUNFLOWER R., in Sharkey County, and Big Sunflower R., in Sharkey and Yazoo Counties, Miss. (S.) (Yazoo & Mississippi Valley R. R. Co.) PLANS.—Approv. Apr. 24, 1906, **06**, 806.

LITTLE TENNESSEE R., Niles Ferry, Tenn. (S.) (Louisville & Nashville R. R. Co.) PLANS.—Br. to replace existing str. approv. Oct. 21, 1904, **05**, 724.

LITTLE WABASH R., New Haven, Ill. (S.) (Gallatin and White Counties br.) PLANS.—Approv. Nov. 9, 1894; modified plans approv. Feb. 23, 1895. Br. completed. **95**, 477.

LIVINGSTONE CREEK, near Cronly, N. C. (S.) (Seaboard Air Line Ry.) PLANS.—Reconstr. approv. Sept. 19, 1907, **08**, 870.

LOCUST FORK, Ala. (See Black Warrior R.)

LOGGY BAYOU, La. (Sp.) (Shreveport & Red River Valley Ry. Co.) LEGISLATION.—Company au. to constr. br. by act Apr. 11, 1898, **99**, 619. PLANS.—Approv. Apr. 12, 1899. Temporary br. for use during constr. of permanent br. au. to be built at this place. **99**, 619.

LONG BEACH CHAN., from Barnum Isld. to Inner Beach, N. Y. (S.) (Hempstead city br.) PLANS.—Approv. Dec. 24, 1896, **97**, 533.

LONG BEACH CHAN., Wreck Lead, Long Isld., N. Y. (Long Island Ry. Co.) PLANS.—Reconstr. of existing br. approv. Apr. 26, 1912, **12**, 1307.

LONG CREEK, near Lynnhaven Inlet, Va. (S.) (Princess Anne County br.) PLANS.—Approv. Feb. 26, 1912, **12**, 1305.

LONG TOM R., Bundys, Oreg. (S.) (Benton County br.) PLANS.—Approv. Feb. 2, 1900. Br. proving unsatisfactory, new plans approv. June 26, 1900. **00**, 701.

LOS ANGELES H., Cal. (across chan. in, leading from turning basin into w. basin). (O.) (2 brs. of Southern Pacific Co. and Los Angeles Interurban Ry. Co.) PLANS.—Alterations of brs. across West Basin and Los Angeles H. to be completed within 12 months, and removal of trestle in Los Angeles H. within 60 days from Dec. 27, 1910, **11**, 1091.

LOS ANGELES R., Cal. (Dr.) **08**, 865.

LOUIS BAYOU, Catahoula Parish, La. (S.) (Catahoula Parish br.) PLANS.—Approv. Sept. 27, 1902, **03**, 646.

LOUISIANA STREAMS, certain. (Dr.) **07**, 815.

LOUISVILLE AND PORTLAND CANAL. (See Ohio R.)

LUDINGTON H., Washington Street, Ludington, Mich. (O.) (City br.) PLANS.—Alterations to be completed on or before June 1, 1907, **07**, 828.

LUDLAMS THOROUGHFARE, Sea Isle City, N. J. (S.) (Cape May County br.) PLANS.—Approv. June 22, 1905, **05**, 728.

LUMBER R., N. C. (O.) Notices served as to alterations required, **90**, 343.

LUMBER R., N. C. (S.) (Wilmington, Columbia & Augusta R. R. Co.) PLANS.—Approv. Jan. 26, 1893, **93**, 467.

LUMBER R., near Fair Bluff, N. C. (S.) (Butters Lumber Co.) PLANS.—Approv. June 8, 1898, **98**, 536.

LUMBER R., Fair Bluff; Princess Ann; Ivey Bluff; Phillips, and Matthews Bluff, N. C. (O.) (Owned jointly by Robeson and Columbus Counties.) **89**, 377; **90**, 343. PLANS.—Alterations required by May 7, 1890, **89**, 378; **90**, 343. Time extended to June 30, 1890, **90**, 343.

LUMBER R., N. C. (A.) (Carolina Central R. R. brs. below Lumberton; W. & C. R. R. brs., S. C., above river's mouth, and a br. at Nicholas.) PLANS.—Should be provided with draw openings, **89**, 2795.

LUMBER R., at Lumberton and Alma, N. C. (Sp.) (Beaufort County br.) Au. act Aug. 5, 1905. PLANS.—Approv. Jan. 18, 1910, **10**, 1020.

LYNCHS R., near Johnsonville, S. C. (S.) (Georgetown & Western R. R. Co.) PLANS.—Approv. Nov. 13, 1911, **12**, 1302.

LYNN-HAVEN INLET, Va. (S.) (Chesapeake Transit Co.) PLANS.—Approv. Mar. 13, 1901, **01**, 665.

LYNN-HAVEN INLET, Va. (O.) (Norfolk & Southern Ry. Co.) PLANS.—Alterations to be completed on or before 3 months from July 25, 1908, **09**, 919.

M.

MABSCO CREEK. (See Pamunkey R.)

MACHIAS R., Machiasport and E. Machias, Me. (S.) (Trustees of Machiasport br.) PLANS.—For reconstr. approv. Sept. 7, 1907, **08,** 869.

MACKEYS CREEK. (See Albemarle Sound.)

MACKEYS CREEK, Mackeys Ferry, N. C. (S.) (Virginia & Carolina Coast R. R. Co.) PLANS.—Approv. July 11, 1906, **07,** 820.

MACKEYS CREEK, N. C. (Dr.) **03,** 642; **09,** 912.

MAD R. SLOUGH, Eureka, Cal. (S.) (Humboldt Northern Ry. Co.) PLANS.—Approv. May 13, 1905, **05,** 727.

MAHONING CREEK, Armstrong County, Pa., at 6 and 11 m. from confluence with Allegheny R. (S.) (Pittsburgh & Shawmut R. R. Co.) PLANS.—Approv. Nov. 26, 1910, **11,** 1084, 1085.

MALDEN R., between Everett and Medford, Mass. (S.) (State br.) PLANS.—Approv. May 1, 1903, **03,** 650, and Feb. 13, 1904, **04,** 716.

MANAHAWKEN B., between Hilliards and Barnegat City Junction, N. J. (S.) (Long Beach Turnpike Co.) PLANS.—Approv. June 17, 1912, **12,** 1308.

MANASQUAN R., between Manasquan and Pt. Pleasant, N. J. (S.) (Monmouth and Ocean Counties br.) PLANS.—Reconstr. plans approv. Nov. 9, 1896, **97,** 532.

MANASQUAN R., between Brele and Pt. Pleasant, N. J. (S.) (New York & Long Branch R. R. Co.) PLANS.—Reconstr. plans approv. May 24, 1911, **11,** 1089.

MANATEE R., Craigs Pt., Fla. (Sp.) (U. S. & West Indies R. R. & S. S. Co.) Au. act May 7, 1902. PLANS.—Approv. Nov. 19, 1902, **03,** 643.

MANATEE R., Manatee, Fla. (S.) (Manatee Br. Co.) PLANS.—Approv. Apr. 12, 1909, **09,** 917.

MANCHAC (Pass), St. John the Baptist Parish, La. (S.) (Illinois Central R. R. Co.) PLANS.—Rebuilding approv. Aug. 5, 1902, **03,** 645.

MANCHESTER H., Mass. (Dr.) **10,** 1019.

MANCHESTER H., Mass. (O.) (Boston & Maine R. R. Co.) PLANS.—Alterations to be completed on or before 12 months from May 18, 1910, **10,** 1032.

MANISTEE R., Smith Street, Manistee, Mich. (S.) (City br.) PLANS.—Approv. Sept. 27, 1893; modification approv. Jan. 18, 1894; **94,** 427.

MANISTEE R., Maple Street, Manistee, Mich. (S.) (City br.) PLANS.—Rebuilding approv. Feb. 11, 1905, **05,** 725.

MANISTEE R., Manistee, Mich. (Sp.) (Manistee Township br.) Au. act May 20, 1908. PLANS.—Approv. Aug. 15, 1908, **09,** 914.

MANITOWOC R., Manitowoc, Wis. (S.) (Chicago & North Western Ry. Co.) PLANS.—Approv. Feb 28, 1899, **99,** 622. Reconstr. approv. Mar. 16, 1910, **10,** 1028.

MANITOWOC R., foot of 8th Street, Manitowoc, Wis. (Sp., etc.) (City br.) LEGISLATION.—City au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Wisconsin. PLANS—For new br. approv. Mar. 8, 1892, **92,** 404.

MANITOWOC R., near High Street, Manitowoc, Wis. (S.) (Manitowoc Terminal Co.) PLANS.—Approv. Jan. 18, 1896, **96,** 426.

MANITOWOC R., Manitowoc, Wis. (S.) (Manitowoc Terminal Co., 2 brs.) PLANS.—For brs, at Main Street and at 8th Street, approv. Aug. 2, 1892, **95,** 480. Modified plans for first crossing, providing for a fixed span with a lift draw, approv. Jan. 18, 1896, **96,** 425, 426.

MANITOWOC R., Main Street, Manitowoc, Wis. (S.) (City br.) PLANS.—Reconstr. plans approv. June 16 1897, **97,** 534.

MANITOWOC R., Manitowoc, Wis. (S.) (Manitowoc, Green Bay & Northwestern Ry. Co.) PLANS.—Approv. Mar. 15, 1905, **05,** 726.

MANITOWOC R., Park and Center Streets, Manitowoc, Wis. (S.) (City br.) PLANS.—Approv. Mar. 4, 1907, **07,** 825.

MANITOWOC R., State and Center Streets, Manitowoc, Wis. (S.) (City br.) PLANS.—Temporary br. approv. Sept. 6, 1900, **01,** 662. Modified plans approv. Sept. 2, 1905, **06,** 801.

MANTUA CREEK. (See Schuylkill R.)

MANTUA CREEK, at Mount Royal, N. J. (S.) (Gloucester County br.) PLANS.—New br. in place of existing str. approv. Dec. 8, 1911, **12,** 1303.

MARSH R., Newcastle, Me. (S.) (Maine Central R. R. Co.—Knox & Lincoln branch.) PLANS.—Rebuilding approv. Apr. 8, 1903, **03.** 649.

MASHPEE R., Mass., over Mashpee R., Opponessett B., and a chan. connecting these waterways between Gooseberry Isld. and the mainland. (S.) (Brs. of the town of Mashpee.) PLANS.—Approv. Feb. 11, 1910, **10,** 1027.

MASON and **BRUSH** (Boush) **CREEKS,** Va. (S.) (Willoughby Bay Traction Co.) PLANS.—Approv. June 8, 1906, **06,** 807.

MASSALONA BAYOU, Fla. (S.) (Panama City br.) PLANS.—Approv. Mar. 25, 1910, **10,** 1028.

MATANZAS R., Fla. (Dr.) **02,** 581.

MATANZAS R., St. Augustine, Fla. (S.) (St. Augustine Br. Co.) PLANS.—Approv. June 10, 1895, **95,** 479.

MATTAPONI R., Walkerton, Va. (S.) (Walkerton & Mattaponi Br. Co.) PLANS.—Approv. Oct. 28, 1898, **99,** 621. Reconstr. of existing br. approv. Mar. 14, 1912, **12,** 1306.

MATTITUCK CREEK, Suffolk County, N. Y. (S.) (Southold town br.) PLANS.—Approv. Sept. 11, 1909, **10,** 1024.

MAUMEE R., Toledo, Ohio. (S.) (City br.) PLANS.—Submitted Feb. 4, 1895; modified Mar. 25, 1895; approv. Apr. 12, 1895, **95,** 478. Modified plans approv. Nov. 16, 1895, **96,** 425. Approv. July 1, 1911, **12,** 1299.

MAUMEE R., Toledo, Ohio. (S.) (Lake Shore & Michigan Southern Ry. Co.) PLANS.—New br. approv. Sept. 27, 1899, **00,** 699.

MAUMEE R., near Toledo, Ohio. (S.) (Maumee Railway Br. Co.) PLANS.—Modified plans for upper br. approv. June 24, 1901, **01,** 667, and Apr. 25, 1902, **02,** 588.

MAUMEE R., Cherry and Main Streets, Toledo, Ohio. (S.) (City br.) PLANS.—Reconstr. approv. Jan. 22, 1907, **07,** 824.

MAURICE R., at Mauricetown, N. J. (S.) (Cumberland County br.) PLANS.—Reconstr. approv. Feb. 21, 1910, **10,** 1027.

MᶜGIRTS CREEK, Duval County, Fla. (S.) (Jacksonville, Tampa & Key West Ry. Co.) Reconstr. plans approv. Aug. 15, 1893, **93,** 470.

MᶜGIRTS CREEK, Fla. (S.) (Duval County br.) PLANS.—Approv. May 28, 1907, **07,** 828.

MᶜGIRTS CREEK, Ortega, Fla. (S.) (Duval County br.) PLANS.—Approv. Jan. 29, 1912, **12,** 1305.

MENOMINEE CANAL, 1st Avenue, Milwaukee, Wis. (S.) (City br.) PLANS.—Approv. July 7, 1905, **06,** 800.

MENOMINEE (North) **CANAL,** Muskego Avenue, Milwaukee, Wis. (S.) (City br.) PLANS.—Rebuilding approv. May 12, 1902, **02,** 588.

MENOMINEE (North) **CANAL,** 6th Street, Milwaukee, Wis. (S.) (City br.) PLANS.—Rebuilding approv. July 26, 1905, **06,** 801.

MENOMINEE (South) **CANAL,** 1st Avenue, Milwaukee, Wis. (S.) (City br.) PLANS.—Rebuilding approv. July 26, 1905; plans in lieu thereof approv. Jan. 31, 1907, **07,** 824, 825.

MENOMINEE (South) **CANAL,** e. of 1st Avenue br., Milwaukee, Wis. (S.) (City br.) PLANS.—Temporary br. approv. Aug. 15, 1907, **08,** 869.

MENOMINEE R., Wis. (Sp.) (Menominee, Mich., and Mariette, Wis., cities' br.) LEGISLATION.—Municipalities au. to constr. br. by act July 29, 1886, **89,** 369. PLANS.—Approv. Sept. 10, 1888; reported completed, **89,** 369.

MENOMINEE R., West Water Street, Milwaukee, Wis. (S.) (City br.) PLANS.—Rebuilding approv. Mar. 13, 1903, **03,** 649.

MENOMINEE R., West Water Street, Milwaukee, Wis. (S.) (Chicago, Milwaukee & St. Paul Ry. Co.) PLANS.—Rebuilding approv. Mar. 13, 1903, **03,** 649.

MENUNKETESUCK R. (See Stony Creek, Conn.)

MENUNKETESUCK R., Conn. (S.) (Br. of the town of Westbrook.) PLANS.—Br. to replace existing str. approv. Mar. 24, 1910, **10,** 1028.

MERMENTAU R., La. (Dr.) **08,** 865.

MERRIMAC R., between Haverhill and Bradford, Mass. (O.) (Cities' br.) PLANS.—Specified alterations required on or before Oct. 1, 1894, **94,** 430.

MERRIMAC R., Haverhill, Mass. (S.) (Essex County br.) PLANS.—Approv. June 23, 1905, **05,** 728.

MERRIMAC R., between Newburyport and Deer Isld., Mass. (S.) (Essex County br.) PLANS.—Rebuilding approv. Apr. 8, 1909, **09,** 917.

MERRIMAC R., Mass. (Dr.) **10,** 1019.

MERRIMAC R., Newburyport and Salisbury, Mass. (S.) (Essex County br.) PLANS.—Rebuilding approv. Dec. 20, 1901, **02,** 586.

MIAMI R., Fla. (Dr.) **03,** 642; **12,** 1294.

MIAMI R., Miami, Fla. (S.) (Florida East Coast Ry. Co.) PLANS.—Approv. Feb. 11, 1903, **03,** 648.

MIAMI R., Miami, Fla. (S.) (J. H. Tatum.) PLANS.—Approv. Oct. 24, 1904, **05,** 724.

MIAMI R., Avenue D, Miami, Fla. (S.) (Dade County br.) PLANS.—Approv. Oct. 15, 1902, **03,** 646.

MIAMI R., N. Fork, Dade County, Fla. (S.) (Dade County br.) PLANS.—Approv. Dec. 17, 1908, **09,** 916.

MICHIGAN CITY, Ind., inner H. (A.) (Michigan Central Ry. br.) PLANS.—Draw opening too narrow, and swinging by hand very laborious, **89,** 2803.

MIDDLE R., Cal. (S.) (San Francisco & San Joaquin Valley R. R. Co.) PLANS.—Approv. Oct. 28, 1898, **99,** 621.

MIDDLE NORTH R., from Generals Isld. to Butler Isld., near Darien, Ga. (S.) (William H. Strain.) PLANS.—Approv. May 12, 1904, **04,** 718.

MIDDLE ISLD. CREEK (St. Marys R.), near St. Marys, W. Va. (S.) (Baltimore & Ohio R. R. Co.) PLANS.—Approv. Oct. 27, 1909, **10,** 1025.

MILL CREEK, Fort Monroe, Va. (Sp.) (Iron pile br.) APPROPRIATIONS.—**1889,** $20,000, **89,** 466. CONTRACTS.—**1889.** Groton Br. & Mfg. Co., br., $17,500, **90,** 387. ENGINEERS.—Chief of Engineers: **Rs., 89,** 12; **90,** 9. Engineer in charge: Lt. Col. P. C. Hains, 1889–90. **Rs., 89,** 465; **90,** 387. OPERATIONS.—**1889–90.** Constr. of br. under contract completed, **90,** 387. PLANS.—Description of proposed str., **89,** 466.

MILL CREEK, at Fort Monroe, Old Point Comfort, Va. (S.) (Hampton Roads Ry. & Electrical Co.) PLANS.—Approv. July 15, 1904, **05,** 722.

MILL CREEK, Humphrey and Lombard Streets, New Haven, Conn. (S.) (City br.) PLANS.—Approv. June 22, 1906, **06,** 808.

MILL CREEK, Thomaston, Me. (S.) (Maine Central R. R. Co.) PLANS.—Approv. Feb. 6, 1899, **99,** 622.

MILL NECK CREEK INLET, from Allens Pt. to Pine Isld. at Bayville, N. Y. (S.) (Oyster B. br.) PLANS.—Approv. Jan. 5, 1897, **97,** 533.

MILL R., Chapel Street, New Haven, Conn. (S.) (City br.) PLANS.—Approv. Apr. 29, 1897, **97,** 534.

MILL R., Conn. (Dr.) **02,** 581.

MILL TAIL CREEK, tributary of Alligator R., Albemarle Sound, Darien County, N. C. (S.) (Dare Lumber Co.) PLANS.—Approv. May 23, 1911, **11,** 1089.

MILL R., New Haven, Conn. (S.) (New York, New Haven & Hartford R. R. Co.) PLANS.—Reconstr. approv. May 21, 1906, **06,** 807.

MILLS CREEK, at Woodmere, N. Y. (S.) (Woodmere Realty Co.) PLANS.—Br. to replace an existing str. approv. May 21, 1910, **10,** 1030.

MILWAUKEE H., Wis. (Dr.) **11,** 1078.

MILWAUKEE R., Milwaukee, Wis. (S.) (City br.) **96,** 426; **99,** 621. PLANS.—Approv. Apr. 14, 1893, **93,** 469. Reconstr. plans for br. at Huron Street, approv. Feb. 25, 1896, **96,** 426. Modified plans providing for a row of fender piling along each abutment, approv. Nov. 1, 1898, **99,** 426.

MILWAUKEE R., Broadway, Milwaukee, Wis. (S.) (City br.) PLANS.—Reconstr. plans approv. Sept. 21, 1899, **00,** 699.

MILWAUKEE R., connecting Grand Avenue and Wisconsin Street, Milwaukee, Wis. (S.) (City br.) PLANS.—Reconstr. plans approv. June 5, 1900, **00,** 701.

MILWAUKEE R., Chestnut Street, Milwaukee, Wis. (S.) (City br.) PLANS.—Reconstr. approv. July 5, 1900, **01,** 661.

MILWAUKEE R., Grand Avenue, Milwaukee, Wis. (S.) (City br.) PLANS.—Temporary br., during constr. of permanent br., approv. Oct. 9, 1901, **02,** 585.

MILWAUKEE R., East Water and Ferry Streets, Milwaukee, Wis. (S.) (City br.) PLANS.—Rebuilding approv. Mar. 24, 1908, **08,** 872.

MILWAUKEE R., Michigan Street, Milwaukee, Wis. (S.) (City br.) PLANS.—Br. to replace existing str. approv. Jan. 9, 1909, **09,** 916.

MILWAUKEE R., Oneida to Wells Streets, Milwaukee, Wis. (S.) (City br.) PLANS.—Br. to replace existing swing br. approv. Feb. 15, 1911, **11,** 1087.

MINGO (or Black Mingo) **CREEK,** at Mingo (or Black Mingo) Br., S. C. (S.) (Br. of Georgetown and Williamsburg Counties.) PLANS.—Approv. Mar. 12, 1907, **07,** 826.

MINNESOTA R., Minn. (Dr.) **10,** 1019.

MINNESOTA R., Savage, Minn. (S.) (Minneapolis, Rochester & Dubuque Traction Co.) PLANS.—Permanent br., and for a temporary br. for use during constr. of the permanent str., approv. Sept. 9, 1907, **08,** 869.

MISSISQUOI B., Alburg Pt., Vt. (S.) (Vermont & Providence Line R. R. Co.) PLANS.—Modified plans approv. Aug. 20, 1897, **97,** 535.

MISSISQUOI B., Vt. (A. and O.) (Lamoille Valley Extension R. R. Co.) **88,** 2652; **90,** 343. LEGISLATION.—Notice served as to altera-required, **90,** 344. PLANS.—Maj. Adams recom. the removal of the br., it being no longer in use and being a great obstr. on account of the narrowness of the draw, **88,** 2652.

MISSISQUOI B., Lake Champlain, between Swanton and Alburg, Vt. (Sp.) (Central Vermont R. R. Co.) Au. act Mar. 4, 1911. PLANS.—Reconstr. plans approv. Apr. 13, 1911, **11,** 1080.

MISSISSIPPI R., between St. Paul and Missouri Rs. (Dr.) **02,** 581.

MISSISSIPPI R., brs. over. (See Ohio R.) ENGINEERS.—Engineer in charge: Maj. G. K. Warren, 1870–79. **R., 70,** 58; (Lt. Col.) **79,** 1462. Maximum grade and curvature of the following brs., **79,** 1462: St. Paul highway, St. Paul railway, Hastings railway, Winona railway (2), La Crosse railway, Prairie du Chien railway (pontoon), Dubuque railway, Clinton railway, Rock Isld. rail and highway, Keokuk rail and highway, Quincy railway, Hannibal rail and highway, Louisiana railway.

MISSISSIPPI R. (O.) **90,** 338. LEGISLATION.—Act Aug. 11, 1888, providing for alteration of strs. impeding navigation, **90,** 338. Notice served upon various br. owners, requiring alterations, **90,** 339.

MISSISSIPPI R., Aitkin, Minn. (Sp.) (Aitkin County br.) LEGISLATION.—Company au. to constr. br. by act Mar. 23, 1896, **96,** 423. PLANS.—Submitted Dec. 2, 1895, and Jan. 30, 1896; approv. May 9, 1896, **96,** 423.

MISSISSIPPI R., Alton, Ill. (Sp.) (St. Clair, Madison & St. Louis Belt R. R. Co.) LEGISLATION.—Company au. to constr. br. by act Aug. 29, 1890. PLANS.—Approv. Aug. 1, 1891, on certain conditions, **91,** 432.

MISSISSIPPI R., Anoka, Minn. (Sp.) (Minneapolis, Superior, St. Paul & Winnipeg Ry. Co.) Au. act June 27, 1902. PLANS.—Approv. Aug. 5, 1902, **03,** 643.

MISSISSIPPI R., at Fort Snelling, Minn. APPROPRIATIONS.—1906, $125,000, **07,** 2475. 1909, $20,000, **09,** 2515. 1910, $1,200, **10,** 2742. Total, $146,200. Contributions: City of St. Paul, $100,000, **07,** 2475. Twin City Rapid Transit Co., $25,000, **07,** 2475. Total, $125,000. ENGINEERS.—Chief of Engineers. **R., 06,** 832; **07,**

861; **08,** 901; **09,** 948; **10,** 1059; **11,** 1118. In charge: Lt. Col. G. McC. Derby. R., **06,** 2279. Capt. E. H. Schulz. R., **07,** 2475. Maj. F. R. Shunk. R., **08,** 2557; **09,** 2515; **10,** 2741; **11,** 3037. OPERATIONS.—**1906–07.** Site surveyed; borings made; land acquired; proposals issued, **07,** 861, 2475. **1907–08.** Work commenced; substr. about 64 per cent completed; abutment St. Paul side completed; Fort Snelling side one-half completed, **08,** 2557. **1908–09.** Substr. work completed; erection of superstr. completed; grading approaches commenced; about 20 per cent of entire work completed, **09,** 2515. **1909–10.** Work suspended Nov., 1909; br. placed in charge of custodian, **10,** 2741. **1910–11.** Street opened; approaches completed; minor repairs, **11,** 3037. PROJECT.—Act Mar. 17, 1906, provides for constr. of br. at limiting cost of $250,000, toward which city of St. Paul to contribute $100,000, not less than $25,000 by street railway company receiving right of transit across br. Site selected for proposed br. about 330′ below old Fort Snelling br. **06,** 832, 2279.

MISSISSIPPI R., Bemidji, Minn. (Sp.) (City br.) Au. act May 20, 1908. PLANS.—Approv. June 18, 1908, **08,** 868.

MISSISSIPPI R., Bemidji, Minn. (Sp.) (Minneapolis, St. Paul & Sault Ste. Marie R. R. Co.) Au. act Mar. 24, 1910. PLANS.—Approv. Aug. 10, 1910 **11,** 1079.

MISSISSIPPI R., near Bemidji, Minn. (Sp.) (Minnesota & International Ry. Co.) Au. act Mar. 12, 1912. PLANS.—Approv. May 27, 1912, **12,** 1298.

MISSISSIPPI R., Blackberry, Minn. (Sp. (Town br.) Au. act Feb. 15, 1911. PLANS.—Approv. Jan. 29, 1912, **12,** 1297.

MISSISSIPPI R., Burlington, Iowa. (Sp.) (Railway.) COMMERCE.—Influence of br. upon navigation, **78,** 1004. ENGINEERS.—Chief of Engineers, R., **77,** 96. Approv. recom. of board, **77,** 817. BE. convened at St. Louis, Mo., July 17, 1876, to inquire into the expediency of placing sheer booms on the upper end of all or any br. p. on the Mississippi R. Adjourned to await the completion of maps. **77,** 821. Reconvened Jan. 26, 1877. Recom. a sheer boom 500′ in length at br. R., **77,** 819, 824. (Cols. Macomb and Simpson, Majs. Warren, Farquhar. and Suter, and Capt. Allen.) LEGISLATION.—Br. au. by act July 25, 1866, **77,** 824; **78,** 1003. Various acts relating to the br., **78,** 1089. PLANS.—Dimensions of br., **77,** 824; **78,** 1003. Description of plans by Maj. Warren, **78,** 1003. High br. would be very expensive, **78,** 1006. Changes in br. proposed by Maj. Warren, **78,** 1006. SURVEYS.—Maps. Diagram of ps., **78,** 1004. Maps of locality of br., Nos. 21 and 22, **78,** 1126.

MISSISSIPPI R., Cass and Itasca Counties, Minn. (S.) (Great Northern Ry. Co.) PLANS.—Br. to replace existing str. approv. Sept. 10, 1907, **08,** 870.

MISSISSIPPI R., Clinton, Iowa. (Sp.) (Pontoon.) ENGINEERS.—Chief of Engineers. R., **75,** 121. Approv. conclusions of BE., **75,** ii, 682. Approv. by Sec. of War, **75,** ii, 683. BE. convened at Clinton, Iowa, Oct. 8, 1874. Recom., **75,** ii, 683. R., **75,** ii, 683. (Col. Macomb, Majs. Weitzel and Farquhar.) LEGISLATION.—Br. au. by acts Apr. 1, 1872, and June 6, 1874, **75,** ii, 682. Various acts relating to the br., **78,** 1093. PLANS.—By br. company, **75,** ii, 683. Modified by BE., **75,** ii, 683.

MISSISSIPPI R., Clinton, Iowa. (Sp.) (Railway.) COMMERCE.—Influence of br. upon navigation, **78,** 989. ENGINEERS.—Chief of Engineers. Approv. recom. of board, **77,** 96, 817. BE. 1876. Recom. constr. of 1,000′ of sheer booms. R., **77,** 819, 825. (Cols. Macomb and Simpson, Majs. Warren, Suter, and Farquhar, and Capt. Allen.) LEGISLATION.—Br. au. by act Feb. 27, 1867, **78,** 987. Abstracts of debates in Congress relating to Clinton br., **78,** 1051. Various acts relating to br., **78,** 1089, 1093. PHYSICAL CHARACTERISTICS.—Description of R. and valley at locality of br., **78,** 987. PLANS.—Description of br., **77,** 823; **78,** 988. Alterations recom. by Maj. Warren, **78,** 989. Proposed location for a high br., **78,** 990. Maj. Warren's R. on br., **78,** 987. SURVEYS.—Maps. Diagram of ps., **78,** 985. Maps of locality of br., **78,** 1126.

MISSISSIPPI R., near Clinton, Iowa. (Sp.) (Clinton & Illinois Br. Co.) ENGINEERS.—Chief of Engineers. R., **91,** 428. BE. constituted by S. O. No. 10, Mar. 11, 1890. (Lt. Col. C. R. Suter, Maj. A. Mackenzie, and Capt. W. L. Marshall.) Engineer in charge: Maj. A. Mackenzie. LEGISLATION.—Company au. to constr. br. by act July 16, 1888; amending act Mar. 1, 1890, **91,** 428. PLANS.—Br. at Stoney Pt. submitted Feb. 1, 1889, withdrawn; new plans with location below br. of the Chicago & North Western Ry. Co. disapprov. July 16, 1889. Plans for a high br. at Stoney Pt. submitted Nov. 12, 1889; referred to BE., who reported Mar. 31, 1890, adversely on this location and suggested a place about 1 m. below city near R. R. br.; revised plans in accordance with above suggestion approv. Sept. 22, 1890. Modification of superstr. of certain spans submitted Jan. 21, 1891; approv. Feb. 10, 1891. Modification of arrangement of e. chan. span submitted June 26, 1891; approv. July 10, 1891. **91,** 428.

MISSISSIPPI R., Clinton, Iowa. (Sp.) (Br. of Albany R. R. Br. Co., by Chicago & North Western Ry. Co.) Au. act Feb. 6 1907. PLANS.—Reconstr. approv. May 4, 1907, **07,** 819.

MISSISSIPPI R., at Cohasset, Minn. (Sp.) (Bass Brook town br.) Au. act Jan. 28, 1910. PLANS.—Approv. May 13, 1910, **10,** 1022.

MISSISSIPPI R., between Davenport, Iowa, and Rock Isld., Ill. (Sp.) (Davenport & Rock Island Ry. Br. Co.) LEGISLATION.—Company au. to constr. br. by act Mar. 3, 1885 **95,**

474. PLANS.—Submitted Nov. 19, 1894; modified Jan. 5, 1895; approv. Jan. 23, 1895, **95**, 474.

MISSISSIPPI R. (Des Moines Rapids Canal), at foot of Des Moines Rapids, above present lower lock in Hancock County, Ill. (S.) (Keokuk & Hamilton Water Power Co.) PLANS.—Temporary br. for use in connection with power development au. by acts Feb. 8, 1901, and Dec. 9, 1905; approv. Mar. 6, 1911, **11**, 1087.

MISSISSIPPI R., Dubuque, Iowa. (Sp.) (Railway.) COMMERCE.—Influence of br. upon navigation, **78**, 985. ENGINEERS.—Chief of Engineers. **R.**, **77**, 96, 817; **83**, 271, 1598; **84**, 271. BE. recom., 1876, a sheer boom 1,200′ in length. **R.**, **77**, 819, 823. (Cols. Macomb and Simpson, Majs. Warren, Farquhar, and Suter, and Capt. Allen.) LEGISLATION.—Br. au. by act July 25, 1866, **78**, 983. Various acts relating to br., **78**, 1089, 1093. Act Mar. 3, 1875, fixed width of the draw span at 500′. Act May 29, 1884, reduced it to 400′, **84**, 271. PHYSICAL CHARACTERISTICS.—Description of R. valley at locality of br., **78**, 983. PLANS.—Description of br., **77**, 823; **78**, 984. Proposed location of high br., **78**, 986. By Maj. Warren for extension of left rest p. 300′, **78**, 986. Modifications in spans discussed by br. company, **83**, 1596, 1598. Recom. by Chief of Engineers, **83**, 1598. Action of Congress necessary before modification can be made, **83**, 1599. Modified by act May 29, 1884, **84**, 271. SURVEYS.—Maps. Diagram of ps., **78**, 985. Maps of locality of br., **78**, 1126 (Nos. 15 and 16).

MISSISSIPPI R., Dubuque, Iowa. (Sp.) **88**, 209. COMMERCE.—Dimensions of the largest Mississippi packet boats, **88**, 2496. LEGISLATION.—Br. au. by act Feb. 21, 1887, **88**, 2498. PLANS.—Maj. Mackenzie reported the dimensions of the br. spans such as to furnish no obstr. to the passage of the largest Mississippi boats, **88**, 2496–97.

MISSISSIPPI R., Dubuque, Iowa. (Sp.) (Pontoon.) **76**, 92, ii, 308. COMMERCE.—Would be seriously obstr. by proposed br., **76**, ii, 311, 313. BE. convened at Dubuque, Iowa, May 31, 1875. Br. on proposed site would be very injurious to navigation. **76**, ii, 311. **R.**, **76**, ii, 309. Reconvened Oct. 15, 1875. Site inadmissible so long as the bar in front of the city exists, **76** ii, 313. **R.**, **76**, ii, 312. Reconvened Mar. 15, 1876. The board approved of the revised plans and change of site presented by the br. company, **76**, ii, 309. **R.**, **76**, ii, 309. Approv. by Chief of Engineers and Sec. of War, **76**, ii, 308. (Col. Macomb and Majs. Farquahr and Suter.) LEGISLATION.—Br. au. by act Mar. 3, 1875, **76**, ii, 308, 309. PLANS.—Submitted by J. P. Quigley, **76**, ii, 309. Description of, **76**, ii, 309. Discussed by board, **76**, ii, 309. **R.** of Maj. Warren, **78**, 986.

MISSISSIPPI R., between Dubuque, Iowa, and Dunleith (East Dubuque), Ill. (Sp.) (Dubuque & Dunleith Br. Co.) **99**, 619. LEGISLATION.—Company au. to constr. br. by act July 25, 1866, **99**, 619. PLANS.—Reconstr. plans approv. Mar. 4, 1899, **99**, 619.

MISSISSIPPI R., Dubuque, Iowa, and East Dubuque, Ill. (S.) (Dubuque High Br. Co.) PLANS.—Reconstr. approv. May 16, 1906, **06**, 807.

MISSISSIPPI R., Eagle Pt., Dubuque, Iowa. (Sp.) (Dubuque & Wisconsin Br. Co.) Au. act Mar. 6, 1900, and Dec. 21 1900. PLANS.—Approv. Jan. 4, 1901, **01**, 660.

MISSISSIPPI R., near Elk R., Minn. (Sp.) (Elk R. village, county of Wright and town of Otsego br.) Au. act Apr. 28, 1904. PLANS.—Approv. Nov. 4, 1904, **05**, 720.

MISSISSIPPI R., Fort Madison, Iowa. (Sp.) LEGISLATION.—Br. au. by acts Apr. 1, 1872, and May 17, 1872, **78**, 1091, 1092.

MISSISSIPPI R., Fort Snelling, Minn. (Sp.) **78**, 111; **80**, 200. BE. approv. plan, **80**, 200. (Gen. Terry and Col. Warren.) LEGISLATION.—Br. au. by act June 30, 1878, **80**, 199, 1869. PLANS.—Constr. of a free wagon br., with st. abutments and iron superstr., **78**, 111. Approv. by Sec. of War, **78**, 111. Test of br. assigned to Capt. C. J. Allen, **80**, 200. **R.**, **80**, 1869.

MISSISSIPPI R., Grand Rapids, Minn. (Sp.) (Town br.) Au. act Mar. 23, 1912. PLANS.—Approv. Apr. 20, 1912, **12**, 1298.

MISSISSIPPI R., Hannibal, Mo. (Sp.) (Railway.) COMMERCE.—Number of rafts passing the br., **77**, 826. Effect of br. upon navigation, **78**, 1017. At h. w. a very serious obstr. to navigation, **78**, 1017. ENGINEERS.—Chief of Engineers. Approv. recom. of board, **77**, 817. BE. recom., 1876, placing of a sheer boom 1,200′ in length at this br. **R.**, **77**, 819, 826. (Cols. Macomb and Simpson, Majs. Warren, Farquhar, and Suter, and Capt. Allen.) LEGISLATION.—Br. au. by act July 25, 1866, **77**, 826; **78**, 1015, 1089. PHYSICAL CHARACTERISTICS.—Description of the R. and valley in the vicinity of the br., **78**, 1015. PLANS.—Dimensions, **77**, 826; **78**, 1016. **R.** of Maj. Warren on plans of br., **78**, 1015. Height required for h. br., **78**, 1019. SURVEYS.—Maps. Of locality of br., **78**, 1126 (No. 27).

MISSISSIPPI R., Hannibal, Mo. (O.) (Wabash R. R. Co., Hannibal Br. Co. & Missouri Pacific Ry. Co.) PLANS.—Alterations to be completed on or before Mar. 15, 1907, **06**, 809.

MISSISSIPPI R., above Hannibal, Mo. (O.) (Hannibal Br. Co., controlled by the Wabash Ry. Co.) PLANS.—Alterations required by Mar. 1, 1889; time extended to Nov. 8, 1888. No action taken by the companies interested. **89**, 373, 374.

MISSISSIPPI R., Hastings, Minn. (Sp.) (City br.) LEGISLATION.—City au. to constr. br. by act June 29, 1894. PLANS.—Approv. Nov. 9, 1894. Reported completed. **95**, 474.

MISSISSIPPI R., Hastings, Minn. (S.) (Railway, draw.) COMMERCE.—Influence of br. upon navigation, **78**, 969. LEGISLATION.—Br. au. by Minnesota, Feb. 7, 1867, **78**, 967. PLANS.—Description of br., **78**, 969. Proposed

location for h. br., 78, 970. Of Maj. Warren for extension of sheer booms and the placing of br. signals above bend in R., 78, 970.

MISSISSIPPI R., Itasca County, Minn. (Sp.) (Itasca County br.) Au. act Apr. 21, 1904. PLANS.—Approv. Aug. 19, 1904, 05, 720.

MISSISSIPPI R., point between Kansas City and 5 m. below, Mo. (Sp.) (Randolph & Kansas City Br. Co.) Company au. to constr. br. by act July 23, 1888. PLANS.—For pontoon draw-span br. approv. July 26, 1889, 89, 372.

MISSISSIPPI R., Keithsburg, Ill. (Sp.) LEGISLATION.—Br. au. by act Apr. 26, 1882, 86, 369. PLANS.—After certain modifications the plan and location were approv. by Sec. of War, 86, 369, 2111.

MISSISSIPPI R., Keithsburg, Ill. (Sp.) (Iowa Central Ry. Co.) Au. act Feb. 25, 1909, PLANS.—Reconstr. approv. Apr. 12, 1909, 09, 913.

MISSISSIPPI R., Keokuk, Iowa. (Sp.) (Rail and high way.) COMMERCE.—Influence of br. upon navigation, 78, 1008. ENGINEERS.—Chief of Engineers. Approv. recom. of board, 77, 96, 817. BE. recom., 1876, placing of 1,200′ of sheer booms. R., 77, 819, 825. (Cols. Macomb and Simpson, Majs. Warren, Farquhar, and Suter, and Capt. Allen.) LEGISLATION.—Br. au. by act July 25, 1866, 77, 825; 78, 1006, 1089. PHYSICAL CHARACTERISTICS.—Description of R. and valley at locality of br., 78, 1006. PLANS.—Dimensions, 77, 825; 78, 1007. Maj. Warren's R. on plans of br., 78, 1006. Alterations proposed by Maj. Warren, 78, 1009. Proposed location of h. br., 78, 1010.

MISSISSIPPI R., Keokuk, Iowa. (O.) (Keokuk & Hamilton br.) 89, 376. LEGISLATION.—Company failed to comply with the requirements of the notice served on them; matter referred, Apr. 13, 1889, to Atty. Gen. for such action as is required by law, 89, 376. PLANS.—Alterations required by Mar. 31, 1889, 89, 376.

MISSISSIPPI R., La Crosse, Wis. (Sp.) (City.) 90, 336. LEGISLATION.—Au. by act Feb. 23, 1889, 90, 336. PLANS.—Plan and location submitted, and approv. by Sec. of War Sept. 30, 1889, 90, 336.

MISSISSIPPI R., La Crosse, Wis. (Railway.) COMMERCE.—R. R. and city interests described and discussed, 73, 564, 574. Growth of Milwaukee & St. Paul R. R. and of Wisconsin, 73, 576. Influence of br. on navigation, 78, 972. ENGINEERS.—Chief of Engineers. R., 73, 63; transmits papers and copies of acts to Maj. Warren for R., 73, 553. R. on sheer booms for br. ps. of Mississippi R., 77, 96, 817. BE. convened at La Crosse, July, 1872, condemned all the sites thereto proposed, and selected a site at foot of Mount Vernon Street, La Crosse, as most suitable for highway as well as R. R. purposes. R., 73, 563, et seq. Reconvened Sept. 25, 1872, upon decision of Atty. Gen (regarding the highway reference in act June 4, 1872, 73, 565); board adhered to their orig. decision, which was approv. by Chief of Engineers and Sec. of War, 73, 572. R., 73, 572. Convened at La Crosse, Wis., Jan. 15, 1875. Recom., 78, 721 722, 723. R., 78, 721. (Col. Macomb and Majs. Weitzel and Merrill.) Recom., 1876, placing of 1,000′ sheer boom above abutment. R., 77, 819, 822. (Cols. Macomb and Simpson, Majs. Warren, Farquhar, and Suter, and Capt. Allen.) LEGISLATION.—Acts of Congress relating to br. Act July 25. 1866, compared in full with act Apr. 1, 1872 73, 561. Act Feb. 21, 1868, described, 73, 555. No br. built under this act, 78, 973. Acts Apr. 1, 1872, and June 4, 1872, described, 73, 555. Act June 4, 1872, in full 73, 563. Opinion of Atty. Gen. regarding reference therein to highways, 73, 570. Various acts relating to br. referred to, 78, 1089, 1091, 1093. PHYSICAL CHARACTERISTICS.—Of La Crosse and region surrounding, 73, 556, 564. Crossings of R. described, 73, 556; 78, 974. PLANS.—Of St. Paul R. R. Co., by J. T. Dodge, filed by A. Mitchell, president, Milwaukee & St. Paul R. R. Co., for br. at Minnesota Isld., 2 m. above La Crosse, crossing the Mississippi and Black Rs., 73, 555. Petition of mayor of La Crosse and president of board of trade, and of governor of Wisconsin, protesting against this location, 73, 555. Letter of J. M. Rusk thereon, requesting a BE., 73, 555. Remarks by Maj. Warren on this plan and site, 73, 557, 560. Location disapprov. by BE., 73, 566. Plan of city of La Crosse for a br. in city, discussed by Maj. Warren, 73, 558; by BE., 73, 566. Plan of Southern Minnesota R. R. Co. for a br. at "Travers de Sioux," 2 m. below the city of La Crosse. Remarks on, by Maj. Warren, 73, 559; by BE., 73, 567. Plan of BE. for a br. at foot of Mount Vernon Street, La Crosse, described, 73, 567. Description of br., 77, 822. Proposed location of h. br., 78, 979. R. of Maj. Warren, 73, 554; 77, 817, 822; 78, 973. SURVEYS.—Maps. Of locality of br., 78, 1126 (Nos. 11 and 12). Diagram of ps., 78, 977.

MISSISSIPPI R., Little Falls, Minn. (Sp.) (City br.) Au. act June 30, 1902. PLANS.—Approv. July 10, 1902, 03, 642.

MISSISSIPPI R., Louisiana, Mo. (Sp.) COMMERCE.—C. and R. R. interests described and discussed by BE., 73, 579. Number of rafts passing the br., 77, 820. Influence of br. upon navigation, 78, 1021. ENGINEERS.—Chief of Engineers. R., 77, 817. BE. convened at St. Louis, Mo., June 21, 1873; reported in favor of site selected, but with modifications of plan, and additions costing $81,800. R., 73, 578. Approv. by Chief of Engineers, 73, 577. (Col. Simpson and Majs. Weitzel, Merrill, and Suter.) Recom., 1876, that the cribwork or bulkhead above the rest p. be extended upstream 500′, and a fixed boom from its upper end 820′. R., 77, 821. (Cols. Macomb and Simpson, Majs. Warren, Farquhar, and Suter, and Capt. Allen.) Approv. by Chief of Engineers, 77, 817. LEGISLATION.—Acts of Congress au. br., Mar. 3, 1871, 77, 826. Acts modifying same, of Apr. 1, 1872, and June 4, 1872, 77, 826; 78, 1018. Acts referred to, 78, 1090. PHYSICAL CHARAC-

TERISTICS.—Description of R. and valley at the locality of br., **78,** 1019. PLANS.—By E. L. Corthell, chief engineer of Louisiana & Missouri River R. R. Co., submitted to Sec. of War, **73,** 578. Objections to same by BE., **73,** 579. Revised by E. L. Corthell, and approv. by Chief of Engineers and Sec. of War, **73,** 584. Description of the br., **77,** 826; **78,** 1019. Accessory works, **78,** 1021. Proposed alterations, **78,** 1022. Proposed location of h. br., **78,** 1024. **R.** of Maj. Warren, **77,** 817; **78,** 1018. SURVEYS.—Maps. Of locality of br., **78,** 1126 (Nos. 28 and 29.) Diagram of ps., **78,** 1020.

MISSISSIPPI R. (Sp.) (Lyons & Fulton Br. Co., at Lyons, Iowa.) **90,** 337. LEGISLATION.—Au. by acts Mar. 2, 1889, and Mar. 15, 1890, **90,** 337. PLANS.—Plan and location submitted, and approv. by Sec. of War, Apr. 22, 1890, **90,** 338.

MISSISSIPPI R., Memphis. (Sp.) (Kansas City & Memphis R. R. & Br. Co.) ENGINEERS.—Chief of Engineers. **R., 88,** 309; **89,** 369. BE. convened at Memphis, May 26, 1888, by S. O. No. 26, to ex. and **R.** upon the plans of the proposed br. across the Mississippi R. at Memphis. Majority **R.** in favor of a main span of 1,000′, 2 other spans of 600′ each, and the whole str. to be 75′ above h. w., **88,** 2517, 2522. (Maj. Ernst, Capt. Kingman, and Capt. Gillette.) Minority **R.** in favor of a main span of 700′, **88,** 2521. (Lt. Col. Merrill.) Sec. of War decided in favor of a main span of 770′, **88,** 2516. LEGISLATION.—Au. by act Apr. 24, 1888, **88,** 2514, 2525. PLANS.—Approv. Aug. 23, 1888, **89,** 369.

MISSISSIPPI R., Minneapolis, Minn. (Stone arch.) ENGINEERS.—Chief of Engineers. **R., 86,** 369. BE. convened to consider the effect of such a br. upon the works of the U. S. for the preservation of the Falls of St. Anthony, **86,** 2111. The board did not think these works would be jeopardized by the constr. of the proposed br., **86,** 2113. (Lt. Col. Poe, Majs. Mackenzie and Allen.) PLANS.—An arch br. of st. of 4 spans of 125′ each, **86,** 2112.

MISSISSIPPI R., near Minneapolis, Minn. (S.) (Chicago, Milwaukee & St. Paul Ry. Co.) PLANS.—Reconstr. approv. Aug. 4, 1900, **01,** 662.

MISSISSIPPI R., Minneapolis, Minn. (Sp.) (Minneapolis, St. Paul & Sault Ste. Marie Ry. Co.) Au. act Jan. 19, 1905. PLANS.—Approv. Mar. 10, 1905, **05,** 721.

MISSISSIPPI R., e. chan., Boom Isld. and Minneapolis, Minn. (S.) (Wisconsin Central Ry. Co.) PLANS.—Approv. June 22, 1905, **05,** 728.

MISSISSIPPI R., slough between Boom Isld. and e. bank, at 5th Avenue, Minneapolis, Minn. (S.) (Wisconsin Central Ry. Co.) PLANS.—Approv. Apr. 14, 1903, **03,** 650.

MISSISSIPPI R., e. bank to Nicollet Isld. and from Nicollet Isld. to Boom Isld., Minneapolis, Minn. (S.) (Wisconsin Central Ry. Co.) PLANS.—Brs. approv. July 24, 1901, **01,** 667.

MISSISSIPPI R., 32d Avenue, Minneapolis, Minn. (Sp.) (City br.) Au. act Jan. 19, 1905. PLANS.—Approv. Feb. 18, 1905, **05,** 721.

MISSISSIPPI R., 42d Avenue, Minneapolis, Minn. (Sp.) (City br.) Au. act Jan. 27, 1912. PLANS.—Approv. Mar. 13, 1912, **12,** 1297.

MISSISSIPPI R., Plymouth Avenue, Minneapolis, Minn. (Sp.) (City br.) Au. act Jan. 27, 1912. PLANS.—Approv. Mar. 15, 1912, **12,** 1297, 1298.

MISSISSIPPI R., near Moose Rapids, Minn. (Sp.) (Minneapolis, St. Paul & Sault Ste. Marie R. R. Co.) Au. act Aug. 5, 1909. PLANS.—Approv. Oct. 27, 1909, **10,** 1020.

MISSISSIPPI R., Minn. (S.) (Eastern Ry. Co.) PLANS.—Approv. Apr. 7, 1898, **98,** 535.

MISSISSIPPI R., Muscatine, Iowa. (Sp.) LEGISLATION.—Br. au. by act Apr. 1, 1872, **78,** 1091.

MISSISSIPPI R., Muscatine, Iowa. (Sp.) (Muscatine Br. Co.) LEGISLATION.—Au. by act July 16, 1888. PLANS.—Plan and location submitted by the company, and approv. by Sec. of War, June 11, 1889, **90,** 336.

MISSISSIPPI R., at or near New Orleans, La. COMMERCE.—C. interests affected, **90,** 3455. ENGINEERS.—Chief of Engineers. **R., 90,** 3453. BE. convened at New Orleans, La., June 14, 1890, by S. O. No. 29, to **R.** upon the erection of a h. level br. across the Mississippi near New Orleans. No br. should be built at or below the city; one could be built above the city without serious obstr. to navigation. **90,** 3454. (Col. Comstock, Lt. Col. Suter, Majs. Ernst and Allen, and Capt. Kingman.)

MISSISSIPPI R. (above and below), New Orleans, La. COMMERCE.—C. interests involved, **90,** 3451. ENGINEERS.—Chief of Engineers. **R., 90,** 3450. BE. convened at New Orleans, La., Nov. 30, 1889, by S. O. No. 47, to **R.** upon the question of the erection of brs. across the Mississippi above and below New Orleans. Board **R.** that any br. across this portion of the R. would be an obstr., and that but 1 br. was needed for R. R. purposes at New Orleans, and that should be located above the city. **90,** 3457. (Col. Comstock, Maj. Allen, and Capt. Kingman.)

MISSISSIPPI R., above New Orleans, La. (Sp.) (Southern Br. & Ry. Co.) LEGISLATION.—Constr. au. by act Jan. 26, 1893. PLANS.—Approv. Apr. 19, 1893, **93,** 465.

MISSISSIPPI R., between the mouths of Pine R. and Dean Brook, Minn. (A.) (Crow Wing County br.) PLANS.—Replacing existing br. with new str. approv. June 2, 1905, **05,** 729.

MISSISSIPPI R., Prairie Du Chien, Wis. (Sp.) (Pontoon railway.) COMMERCE.—Influence of br. on navigation, **78,** 983. ENGINEERS.—Chief of Engineers. **R., 74,** 71. Approv. recom. of board, **77,** 96, 817. BE. Sheer booms, 1876 not necessary, **77,** 819, 823. (Cols. Macomb and Simpson, Majs. Warren, Farquhar, and Suter, and Capt. Allen.) LEGISLATION.—Br. au. by act July 25, 1866, **78,** 980. Legalized by act June 6, 1874, **77,** 823. Various acts relating to br., **78,** 1089, 1093. PLANS.—Description of br., **74,** 681; **77,** 823; **78,** 981. **Rs.** of Col. Macomb and E. F. Hoffman, **74,** 681. Plan of br. designed by J. Lawler, **78,** 983. Plan discussed by Maj. Warren, **78,** 983. Proposed location of h. br., **78,** 983. PHYSICAL CHARACTERISTICS.—Description of R. in vicinity of br., **78,** 980. SURVEYS.—Maps. Of locality of br., **78,** 1126 (Nos. 13 and 14).

MISSISSIPPI R., between Prairie Du Chien Wis., and North McGregor, Iowa. (Sp.) (Chicago, Milwaukee & St. Paul Ry. Co.) LEGISLATION.—Company au. to reconstr. br. by act Mar. 30, 1898. PLANS.—Reconstr. plans approv. June 29, 1898, **98,** 532.

MISSISSIPPI R., Quincy, Ill. (Sp.) (Railway.) COMMERCE.—Influence of br. upon navigation, **78,** 1012. ENGINEERS.—Chief of Engineers. Approv. the recom. of board, **77,** 96, 817. BE. recom. a fixed sheer boom 1,000′ in length. **R.,** **77,** 819, 825. (Cols. Macomb and Simpson, Majs. Warren, Farquhar, and Suter, and Capt. Allen.) LEGISLATION.—Br. au. by act July 25, 1866, **78,** 1010. Various acts relating to br. referred to, **78,** 1089, 1091. PHYSICAL CHARACTERISTICS.—Description of the R. and valley at location of br., **78,** 1010. PLANS.—Dimensions of br., **77,** 825; **78,** 1011. **R.** of Maj. Warren, **78,** 1010. Alterations necessary, **78,** 1014. Proposed location of h. br., **78,** 1015. Incompatibilities of the law for building drawbrs., **78,** 1014. SURVEYS.—Maps. Of location of br., **78,** 1126 (Nos. 25 and 26). Diagram of ps., **78,** 1011.

MISSISSIPPI R., Quincy, Ill. (Sp.) (Chicago. Burlington & Quincy R. R. Co.) Au. act Apr. 24, 1902. PLANS.—Rebuilding draw span approv. May 3, 1902, **02,** 583.

MISSISSIPPI R., Red Wing, Minn. (Sp.) LEGISLATION.—Br. au. by acts July 25, 1866, and June 10, 1872, **78,** 1092.

MISSISSIPPI R., Red Wing, Minn. (Sp.) (City br.) LEGISLATION.—City au. to constr. br. by act May 12, 1894. PLANS.—Approv. June 16, 1894, **94,** 425.

MISSISSIPPI R., near Royalton, Minn. (Sp.) (Minneapolis, St. Paul & Sault Ste. Marie Ry. Co.) Au. act Feb. 1, 1907. PLANS.—Approv. May 8, 1907, **07,** 819.

MISSISSIPPI R., Ill. (Rock Isld. br. over, constr. of). (Sp.) APPROPRIATIONS.[1]—1867, $200,000, **70,** 252. 1869, $500,000, **70,** 253. 1870, $300,000, **70,** 58. 1877, $15,000 (sheer booms), **77,** 145; **78,** 97. Total, $1,015,000. COMMERCE.—Effect of br. on navigation, **77,** 824; **78,** 1002. CONTRACTS.—Harvey & Livesey, masonry, **71,** 299. Annulled for lack of energy, **71,** 300. Efforts to obtain damages, **71,** 300. Baltimore Br. Co., 3 spans of superstr., $459,784, **71,** 301; contract extended, **71,** 302. Satisfactory work done, **72,** 279, 292. Eau Claire Lumber Co., constr. of sheer booms at br., **77,** 818. Proposals to be invited for plans 1, 2, and 3 of Maj. Warren and for spans of 80, 150, and 190′, **70,** 262. Specifications on which proposals were based, **72,** 286. For superstr.; abstracts of, **71,** 301; **72,** 287. ENGINEERS.—Chief of Engineers. **Rs.,** **68,** 50; **69,** 44; **70,** 58, 240; **71,** 57; **72,** 49; **73,** 52; **77,** 96, 817; **78,** 97; **79,** 132. Letter of, to Maj. Warren, stating objections of Lt. Col. Rodman to location of draw, **70,** 229. BE. reported, 1859, that the br. not located or constr. with proper regard to the interests of navigation, ps. not of the best form, and improperly placed with reference to direction of currents, **67,** 291; **68,** 1036. (Capts. Humphreys, Meade, and Franklin.) Board of commissioners au. by Congress, Apr. 19, 1864, **70,** 247. Report of, **70,** 248. Limited in expend. on br., **70,** 253. Control of br. assigned to Engineer Dept., **69,** 44. (Brig. Gen. Schofield, J. Barnes, and S. M. Church.) To ex. and **R.** on the expediency of constr. sheer booms, to be placed at the upper end of all or any br. ps. on the Mississippi R., **77,** 821. Recom. the removal of the remains of the old n. p. and the constr. of sheer booms, **77,** 819, 824. (Cols. Macomb and Simpson, Majs. Warren, Farquhar, and Suter, and Capt. Allen.) Engineers in charge: Maj. G. K. Warren, 1869–71. **R.** on brg. navigable waters of the U. S., **68,** 315; **78,** 900, 991, 1033. **Rs.,** **69,** 194; **70,** 236, 240, 256. Col. J. N. Macomb, 1871–78. **Rs.,** **71,** 256; **72,** 279; **73,** 415; **78,** 710. Maj. F. U. Farquhar, 1878–79. **Rs.,** **78,** 710; **79,** 1144. Maj. D. W. Flagler (Ordnance), **79,** 1144, 1145. Assistants: Capt. W. H. H. Benyaurd, in charge of designs for superstr., **69,** 199. **Rs.,** **70,** 263; **71,** 301; **72,** 286. Capt. A. Stickney, in charge of masonry, **69,** 199. **Rs.,** **71,** 298; **72,** 293. Capt. A. H. Burnham, in local charge, **73,** 416. G. B. Nicholson, inspector of ironwork, **72,** 292. E. F. Hoffman. **R.,** **79,** 1145. ESTIMATES (see Plans and Projects).—By E. H. Johnson, C. E., of Chicago, Rock Island & Pacific R. R. (made for board of commissioners), for a single-track br., with passage for highway 17′ wide, $1,296,292, **69,** 194; **70,** 237, 249. By Maj. Warren, on basis and plans of E. H. Johnson, for double-track R. R. and highway br., with approaches, $2,134,168, **69,** 194; **70,** 251. Est. saving of plan suggested by Maj. Warren over plan of E. H. Johnson, $125,966, **69,** 195. By Lt. Col. T. J. Rodman, U. S. A., plan No. 1, $1,234,525; plan No. 2, $978,085, **70,** 257. Plan No. 3, $934,291, **70,** 258. By Maj. Warren, plan No. 2, $2,187,547, **70,** 246, 264. Plan No. 3, $1,282,356, **70,** 246, 266. Cost to U. S. of plan No. 3, $587,675; cost to R. R. company of plan No. 3, $694,681, **70,** 246. Review of previous ests., **78,** 992. EXPENDITURES (see also Financial statements).—On part of U. S. not to exceed $1,000,000, **70,** 253. Relative expense to be borne by U. S. and R. R.

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[1] Reversion to Treasury of $500,000, **70,** 58; reappropriated, **71,** 256. Congress provides that expenditures on part of the U. S. shall not exceed $1,000,000, **70,** 253. Statements of appropriations, **69,** 44; **70,** 58, 252, 253; **71,** 57, 256.

company, **70,** 237, 246. FINANCIAL STATEMENTS.—**71,** 256, 262; **72,** 279, 285; **73,** 416; **78,** 97, 711; **79,** 132, 1145. Payment to U. S. by R. R. company, $177,320.25, **73,** 415. LEGISLATION.—Act June 27, 1866, * * * for estab. of an armory * * * on Rock Isld.; au. Sec. of War to fix location of br., and to grant to the R. R. companies and other parties in interest pecuniary aid toward changing present location of br. and road; action to be under control of board of commissioners, as fixed by act Apr. 19, 1864, **70,** 247, 254. Act July 25, 1866, to au. constr. of certain brs., * * * fixing minimum h. of lower chord above h. w., length of span, and position of ps., **70,** 249. Act Mar. 2, 1867, making app. for support of Army and other purposes, $200,000 provided for the constr. of br. at Rock Isld., **70,** 252. Act Mar. 3, 1869, making app. for support of Army and other purposes, $500,000 provided for constr. of br. at Rock Isld., **70,** 253. Act July 20, 1868, in relation to br., au. commencement of, with general provisions and conditions, and providing that the expend. on part of U. S. shall not exceed $1,000,000, **70,** 253, 255. Action of Congress allowed a change to single-track R. R. br. with highway beneath, **70,** 239. Various acts relating to constr. of brs., **77,** 145, 824; **78,** 1089, 1091. OPERATIONS.—**1868–69.** Work commenced by contract on the Davenport abutment, **69,** 198. **1869–70.** Progress on substr.; completion of Davenport abutment; constr. of cofferdam at draw pr.; embankment for Davenport wagon road in progress, **70,** 224; **71,** 298. **1870–71.** Completion of ps. Nos. 1, 2, 3, and 4; masonry for pivot p. and Davenport wagon road embankment, **71,** 298. Work taken from contractor and prosecuted with hired labor, **71,** 300. Operations on superstr. commenced, **71,** 301. **1871–72.** Removal of r. from draw-span chan. and completion of superstr. May 8, 1872, **72,** 291, 295. **1872–73.** Final completion and opening of br. and transferment to Ordnance Dept., Feb. 4, 1873, **73,** 52, 415. **1877–78.** 1,150 l. f. of sheer boom built, **78,** 97, 710, 997. **1878–79.** Repairs of sheer boom, **79,** 132, 1144, 1145. PHYSICAL CHARACTERISTICS.—Of valley of R., **68,** 315. Sectional area of natural waterway at location of br., **69,** 197; **78,** 1001. Velocity of current at br., **69,** 197. PLANS (see Estimates and Projects).—For wagon way, width 26′, with 2 sidewalks, of 6′ each, considered by board of commissioners and rejected as giving pivot p. too great width, **69,** 194; **70,** 242. By E. H. Johnson, for single-track R. R., truss to be 16′ wide, with wagon road (without sidewalks) 17′ wide, **69,** 194; **70,** 237, 241, 249. By Lt. Col. Rodman, U. S. A., as follows: (1) Truss wide enough for double-track R. R. and h. enough for wagon road above R. R., **70,** 257; (2) same arrangement of track and road, but only wide enough for single track, **70,** 257; (3) same as plan No. 2, but with wagon road below single-track R. R., **70,** 258. By Maj. Warren, placing R. R. above wagon road: (1) Truss 33′ h., 28′ apart, wagon way 28′ wide and 12′ h., R. R. with double tracks and 2 sidewalks, to be reached by steps from ends, **69,** 195; **70,** 244, 262; (2) trusses of same general dimensions as preceding, wagon road 18′ wide, with 2 5′ sidewalks, double-track R. R. above, **69,** 195; **70,** 244, 262; (3) single-track R. R., trusses 18′ wide, with wagon road beneath 18′ wide, and 2 sidewalks (outside of trusses) 5′ wide, **69,** 195; **70,** 244, 262. Maj. Warren recom. plan No. 3, **70,** 246. General details of proposed plans, **70,** 263. PRIVATE AND CORPORATE WORK. (See Legislation.) PROJECTS (see Estimates and Plans).—Congress, June 27, 1866, au. Sec. of War to fix location of br. and grant pecuniary aid to parties interested, to aid them in changing present location and rebuilding, the details to be under immediate control of board of commissioners, **70,** 247, 254. Congress, July 25, 1866, fixing height of lower chord above h. w. on navigable streams; also length of spans and position of ps., **70,** 249. Proposition of Chicago, Rock Island & Pacific R. R. Co. as to joint action with U. S., **70,** 248. Agreement and guaranty of, **70,** 254. Proj. adopted by board of commissioners (Brig. Gen. J. M. Schofield, J. Barnes, and S. M. Church.) The U. S. to build over main chan. a br. with iron draw, the truss to be of proper width for double track, the wagon way to be planked h. enough to leave lower chord for R. R. track, **69,** 194; **70,** 248. The Chicago, Rock Island & Pacific R. R. Co. to have right of way over same, provided they pay to the U. S. one-half the cost of constr. and mainten. of the part over the main chan., **70,** 248, 253; it being provided that in no case shall the expend. on the part of the U. S. exceed $1,000,000, **70,** 253, 256; proj. approv. by Chief of Ordnance. By order of Sec. of War constr. of br. placed under control of Engineer Dept., **69,** 44. Modifications of law or plan necessary, **69,** 194. Doubt as to details of plan adopted by board of commissioners, **69,** 194; **70,** 237, 241. Maj. Warren submitted that board est. for single-track R. R. and narrow wagon road, **69,** 194; **70,** 237, 241. Ps. designed and built so that either double or single track br. could be put on them, **69,** 195; **70,** 240. Recom. of Chief of Ordnance practically annulled, **70,** 243. Proj. of Maj. Warren, an iron br. for single-track R. R. with wagon way beneath; trusses to be 18′ apart, wagon way 18′ wide and 12′ h., with 2 sidewalks 5′ wide and outside of truss, **69,** 195; **70,** 244, 246, 262. Dimensions of br., **71,** 301; **72,** 287; **77,** 824; **78,** 1002. Location of axis of br., **69,** 196; of draw, **69,** 196, 198; **70,** 229. Objections by Lt. Col. Rodman, **69,** 196; **70,** 229. Specifications for superstr., **72,** 286, 293. Draw span, details of, **72,** 288, 293. Effect of combined R. R. and highway br.; R. R. above highway most desirable, **70,** 261. Test and acceptance of br., **72,** 291. Completion and transferment to Ordnance Dept., **73,** 53, 415. History of, **70,** 237, 241; **73,** 416; **78,** 992, 1002, 1003.

MISSISSIPPI R., Sabula, Iowa. **81,** 268, 2016. LEGISLATION.—Br. au. by act Apr. 1, 1872, **81,** 268. PLANS.—Requirements of Congress,

81, 2015. Maj. A. Mackenzie reported that the plans and location of br. as proposed by the R. R. company interfered as little as possible with the requirements of navigation, **81**, 2016, 2018.

MISSISSIPPI R. (upper), below Falls of St. Anthony. (See Navigable waters of the U. S.)—P. 2203 this Index.

MISSISSIPPI R., St. Louis, Mo. (Sp.) COMMERCE.—Br. a very serious obstr. to navigation, **74**, 641. Names and dimensions of boats which pass the br., **74**, 648. Height of steamboat chimneys, **74**, 654. Importance of completion of the br., **74**, 671. ENGINEERS.—Chief of Engineers. **R.**, **74**, 71, 636. Approv. **R.** of BE., **74**, 637. BE. convened at St. Louis, Mo., Sept. 2, 1873. Considered the br. being constr. a very serious obstr. to navigation, **74**, 641. Modification proposed, **74**, 641. **R.**, **74**, 638. Reconvened at St. Louis, Jan. 14, 1874. Recom. constr. of a canal behind the e. p., with a draw; est., $1,172,436, **74**, 650. Review of first **R.** of board by J. B. Eads, **74**, 665. Reply of board, **74**, 653. "The substance of Mr. Eads's reply is that the majority of R. steamboats must be rebuilt to conform to his br.," **74**, 662. Statements of various persons relating to **R.** of BE., **74**, 664, 670, 671, 673, 674. Personal statement of Col. J. H. Simpson in reply to Mr. Eads, **74**, 675. Of Maj. G. K. Warren, **74**, 678. **Rs.** of board referred to, **78**, 1077. Sec. of War approv. **R.** of board, **74**, 638. (Col. Simpson and Majs. Warren, Weitzel, Merrill, and Suter.) LEGISLATION.—Br. au. by act July 20, 1868, **74**, 637, 643. Various acts relating to the br. referred to, **78**, 1089, 1090, 1091, 1093. PHYSICAL CHARACTERISTICS.—Description of the R. and valley at locality of br., **78**, 1024. H.-w. records, **74**, 644, 645, 646. Duration of each stage, **74**, 648. PLANS.—Plan and est. of J. B. Eads, **78**, 1060. Description of brs., **78**, 1025. Review of Mr. Eads's est., **78**, 1028. **R.** of Maj. Warren upon br., **78**, 1024. Description of proposed modifications of plans, by BE., **74**, 650. History of br., **78**, 1055. Designs of brs. proposed by J. A. Roebling, C. E., **78**, 1078. Sources of information concerning br., **78**, 1078.

MISSISSIPPI R., St. Louis, Mo. **R.** of board of 1886. Board decidedly of opinion that a low br. with a draw should not be au. below the mouth of the Missouri R., **87**, 338, 2638.

MISSISSIPPI R., St. Louis, Mo. (St. Louis Merchants' Br. Co.) LEGISLATION.—Company au. to constr. br. by act Feb. 3, 1887. Amended act Sept. 10, 1888. PLANS.—Approv. Nov. 14, 1888, **89**, 369.

MISSISSIPPI R., St. Louis, Mo. (Sp.) (St. Clair & Carondelet Br. Co.) COMMERCE.—Navigation of the Ohio compared with the Mississippi R., **75**, ii, 680. ENGINEERS.—Chief of Engineers. **R.**, **75**, 121. Approv. report of board, **75**, ii, 677. BE. convened at St. Louis, Mo., Aug. 3, 1874. Recom.—1. Acceptance of site No. 2, on certain conditions. 2. Prohibition of an arched br. 3. Reduction of chan. openings to 450′. 4. Constr. of a draw, **75**, ii, 681. Comparison with other brs., **75**, ii, 680. **R.**, **75**, ii, 678. Approv. by Sec. of War, **75**, ii, 677. (Col. Simpson and Majs. Merrill and Suter.) LEGISLATION.—Br. au. act Mar. 3, 1873, **75**, ii, 678. Various acts relating to the br., referred to, **78**, 1070, 1093. PLANS.—Description of plans, **75**, ii, 678.

MISSISSIPPI R., Salisbury Street, St. Louis, Mo. (Sp.) (St. Louis Electric Br. Co.—McKinley Br.) Au. act Feb. 15, 1907. PLANS.—Approv. July 5, 1907, **08**, 866.

MISSISSIPPI R., St. Louis, Mo. (Sp.) (City br.) Au. act June 25, 1909. PLANS.—Approv. Dec. 17, 1908. Modified plans approv. May 20, 1909, **09**, 913.

MISSISSIPPI R., St. Paul. COMMERCE.—Influence of br. upon navigation, **78**, 967. Formerly a toll br., **78**, 967. PLANS.—Description of br., **78**, 965. Maj. Warren's **R.** on plan of br., **78**, 965. SURVEYS.—Maps. Of locality of br., **78**, 1126 (No. 6). Diagram of ps., **78**, 966.

MISSISSIPPI R., St. Paul, Minn. (S.) (Railway.) COMMERCE.—Influence of br. upon navigation, **78**, 965. Br. opened for travel in 1869, **78**, 963. Damages by collision with ps., decisions of the U. S. Supreme Court, **78**, 1019. LEGISLATION.—Br. au. by act Legislature of Minnesota, Feb. 20, 1855, **78**, 963. PHYSICAL CHARACTERISTICS.—Description of R. near location of br., **78**, 963. PLANS.—Description of br., **78**, 963. Proposed location of h. br., **78**, 963. Maj. Warren recom. br. company be compelled to imp. R. above the br., **78**, 965. **R.**, **78**, 964. SURVEYS.—Maps. Of location of br., **78**, 1126 (No. 5).

MISSISSIPPI R., St. Paul, Minn. (Sp.) (City br.) LEGISLATION.—City au. to constr. br. by act July 5, 1884; amending act Aug. 29, 1890. PLANS.—Approv. Dec. 17, 1890, **91**, 430.

MISSISSIPPI R., South St. Paul, Minn. (Sp.) (South St. Paul Belt R. R. Co.) **94**, 425; **95**, 474. LEGISLATION.—Company au. to constr. br. by act Apr. 26, 1890; amended by acts Feb. 24, 1891; Feb. 15, 1892; and Feb. 15, 1893, **94**, 425. PLANS.—Submitted Dec. 7, 1893; modified Jan. 16, 1894; approv. Feb. 7, 1894, **94**, 425. Revised plans submitted Oct. 12, 1894; approv. Nov. 1, 1894, **95**, 474.

MISSISSIPPI R., St. Paul, Minn. (Sp.) (St. Paul Br. & Terminal Ry. Co.) Au. act Dec. 18, 1908. PLANS.—Approv. Feb. 16, 1909, **09**, 913.

MISSISSIPPI R., St. Paul, Minn. (Sp.) (Chicago Great Western R. R. Co.) Au. Feb. 15, 1911. PLANS.—For replacing existing str. approv. May 24, 1911, **11**, 1081. Modified plans approv. May 17, 1912, and instrument dated May 24, 1911, canceled, **12**, 1298.

MISSISSIPPI R., Thebes, Ill., and Grays Pt., Mo. (Sp.) (Southern Illinois & Missouri Br. Co.) Au. act Jan. 26, 1901. PLANS.—Approv. Jan. 16, 1902. Modified plans for increased length of clear span approv. Mar. 17, 1902, **02**, 582.

MISSISSIPPI R., Warsaw, Ill. (Sp.) LEGISLATION.—Br. au. act May 17, 1872, **78**, 1091, 1092.

MISSISSIPPI R., Winona, Minn. (Sp.) (City br.) LEGISLATION.—City au. to constr. br. by act Sept. 25, 1890. PLANS.—Approv. June 4, 1891, **91,** 431.

MISSISSIPPI R., Winona, Minn. (Sp.) (Railway.) COMMERCE.—Influence of br. upon navigation, **78,** 972. ENGINEERS.—Chief of Engineers. **R., 77,** 96. Approv. recom. of board, **77,** 817, 818. BE. recom., 1876, straight sheer boom from p. to 150′ above the elevator. **R., 77,** 819, 822. (Cols. Macomb and Simpson, Majs. Warren, Farquhar, and Suter, and Capt. Allen.) LEGISLATION.—Br. au. act by July 25, 1866, **77,** 822; **78,** 970, 1089. PLANS.—Description of br., **77,** 822; **78,** 971. Proposed location of h. br., **78,** 973. **R.** of Maj. Warren, **78,** 970. SURVEYS.—Maps. Of locality of br., **78,** 1126 (Nos. 9 and 10). Diagram of ps., **78,** 971.

MISSISSIPPI R., Winona, Minn. (Sp.) (Winona & Southwestern Ry. Co.) LEGISLATION.—Company au. to constr. br. by act Aug. 13, 1888. PLANS.—Approv. July 9, 1890. Sept. 7, 1891, br. reported completed. **91,** 427.

MISSOURI R. and tributaries. (Dr.) **10,** 1019.

MISSOURI R., at American Isld. and the town of Chamberlain, S. Dak. (Sp.) (White River Valley Ry. Co.) Au. act Feb. 9, 1905. PLANS.—Approv. May 10, 1905, **05,** 721, 722.

MISSOURI R., Atchison, Kans. (Railway, draw.) PLANS.—Description of br. by Maj. Warren, **78,** 1087.

MISSOURI R., Atchison, Kans. (O.) (Atchison & Eastern Br. Co.) PLANS.—Alterations to be completed on or before 1 year from Feb. 24, 1908, for constr. of new draw span, or 4 months from Feb. 24, 1908, for providing chan. through existing draw span, **08,** 874.

MISSOURI R., Bellefontaine Bluffs, Mo. (Sp.) (St. Louis, Keokuk & Northwestern R. R. Co.) LEGISLATION.—Au. act Feb. 17, 1888. PLANS.—Plan and location submitted, and approv. by Sec. of War, Dec. 21, 1889, **90,** 337.

MISSOURI R., Boonville, Mo. (Sp.) (Boonville & Howard County Br. Co.) LEGISLATION.—Company au. to constr. br. by act May 25, 1896. PLANS.—Approv. Sept. 11, 1896, **97,** 529.

MISSOURI R., Boonville, Mo. (Sp.) (Railway, draw.) LEGISLATION.—Br. au. act May 11, 1872. PLANS.—Description of br. by Maj. Warren, **78,** 1087.

MISSOURI R., Brownville, Nebr. (Sp.) LEGISLATION.—Br. au. act June 4, 1872, **78,** 1092.

MISSOURI R., between Cass County, Nebr., and Mills County, Iowa. (Sp.) (Plattsmouth Pontoon Br. Co.) Au. act June 28, 1902. PLANS.—Approv. Apr. 30, 1903, **03,** 644.

MISSOURI R., between Council Bluffs, Iowa, and East Omaha, Nebr. (Sp.) (Omaha Br. & Terminal Ry. Co., formerly the Interstate Br. & Street Ry. Co.) LEGISLATION.—Constr. au. by act Feb. 13, 1891; amending act Jan. 28, 1893, and act May 23, 1902. PLANS.—Orig. plans approv. Mar. 5, 1891; modified plans approv. May 9, 1893, **91,** 431; **93,** 465. Replacing temporary br. with permanent str. approv. July 10, 1902, **03,** 642.

MISSOURI R., Glasgow, Mo. (Sp.) ENGINEERS.—Chief of Engineers. **R., 78,** 111. Approv. conclusions of board, **78,** 897. BE. convened at St. Louis, Mo., Apr. 15, 1878. Board approv. plan and location proposed by R. R. company. **R., 78,** 897. (Col. Simpson, Maj. Suter, and Capt. Allen.) LEGISLATION.—Br. au. act Mar. 3, 1871, **78,** 1091. PLANS.—Dimensions of proposed br., **78,** 898. Letter from W. S. Smith to Sec. of War, transmitting plans and drawings, **78,** 897.

MISSOURI R., Jefferson City, Mo. (Sp.) (Jefferson City Br. & Transit Co.) LEGISLATION.—Company au. to constr. br. by act May 28, 1894; amending act Jan. 8, 1895. PLANS.—Approv. July 22, 1895; d. of w. to and through draw spans to be maintained at not less than that found in adjacent imp. parts of the R., **95,** 476.

MISSOURI R., Jefferson City, Mo. (O.) (Jefferson City Br. & Transit Co.) PLANS.—Alterations to be completed on or before 6 months from Feb. 24, 1908, **08,** 874.

MISSOURI R., pt. between Kansas City and 5 m. below, Mo. (Sp.) (Randolph & Kansas City Br. Co.) LEGISLATION.—Company au. to constr. br. by act July 23, 1888. PLANS.—Pontoon draw-span br. approv. July 26, 1889, **89,** 372.

MISSOURI R., Kansas City, Mo. (Sp.) **69,** 51, 307. COMMERCE.—Complaints against the br. as an obstacle to navigation, **69,** 307, 308. LEGISLATION.—Act au., referred to, **69,** 306. Act July 25, 1866, partly given, **69,** 309; **78,** 1089. PHYSICAL CHARACTERISTICS.—Of Missouri R., at Kansas City, **69,** 304. PLANS.—Description of proposed br., **69,** 304; **78,** 1087. Objections to location arising from the difficulty in seeing the br. by descending boats, **69,** 306. **R.** of Capt. Suter **69,** 303, 304.

MISSOURI R., Kansas City, Mo. (Sp.) (Kansas City, Parkville & St. Joseph Electric Ry. Co.) Au. acts Feb. 28, 1903, and Mar. 29, 1904. PLANS.—Approv. June 25, 1904, **04,** 713.

MISSOURI R., Grand Avenue, Kansas City, Mo. (Sp.) (Kansas City, St. Joseph & Excelsior Springs Ry. Co.) Au. act May 16, 1906. PLANS.—Approv. Feb. 11, 1907, **07,** 818.

MISSOURI R., Kansas City, Mo. (Sp.) (Union Depot Br. & Terminal Co.) Au. act Mar. 3, 1887, and Feb. 20, 1907. PLANS.—Approv. Mar. 19, 1908, **08,** 867.

MISSOURI R., Kansas City, Mo. (Sp.) (Chicago, Burlington & Quincy R. R. Co.) Au. act July 25, 1866. PLANS.—Reconstr. approv. Oct. 5, 1911, **12,** 1296.

MISSOURI R., Leavenworth, Kans. (Railway.) PLANS.—Description of br. by Maj. Warren, **78,** 1087.

MISSOURI R., between Leavenworth, Kans., and Platte County, Mo. (Sp.) (Leavenworth & Platte County Br. Co.) ENGINEERS.—

89, 372; **91**, 428; **92**, 405. LEGISLATION.—Company au. to constr. br. by act Feb. 25, 1889, **89**, 372; amending act July 25, 1890, **91**, 428. PLANS.—For a pontoon br. approv. June 20, 1889, **89**, 372. Act of July 25, 1890, provided for a pivot drawbr. instead of a pontoon; plans approv. Sept. 25, 1890, **91**, 428. Plans approv. to change the location from Cherokee to Choctaw Street, Leavenworth, Apr. 27, 1892, **92**, 405.

MISSOURI R., Lexington, Mo. (Sp.) LEGISLATION.—Br. au. by acts July 25, 1866, and Mar. 3, 1873, **78**, 1093.

MISSOURI R., Lexington, Mo. (Sp.) (Lexington Br. & Terminal Co.) LEGISLATION.—Company au. to constr. br. by act July 26, 1894. PLANS.—Approv. July 9, 1895, **95**, 475.

MISSOURI R., Lexington, Mo. (Sp.) (Lexington & Suburban Ry. Co.) Au. Apr. 28, 1904. PLANS.—Approv. Aug. 18, 1904, **05**, 720.

MISSOURI R., Nebraska City, Nebr. (Sp.) COMMERCE.—Rafting interests insignificant on the Missouri R., **73**, 589. R. R. interests, **73**, 591. ENGINEERS.—Chief of Engineers. **R.**, **88**, 308. BE. convened at Nebraska City, Jan. 20, 1873; approv. site and plan with slight modifications. **R.**, **73**, 588. Concurred in by Chief of Engineers and approv. by Sec. of War, **73**, 587. (Col. Simpson and Majs. Weitzel and Suter.) LEGISLATION.—Br. au. by act June 4, 1872, **73**, 586; **88**, 2464. Various acts relating to the br., **78**, 1090, 1094. PLANS.—Submitted to Sec. of War by Nebraska City Br. Co., Dec. 5, 1872. Briefly described by Chief of Engineers, **73**, 586. Lt. Col. Suter approv. the location and dimensions of the proposed br., with the exception that the proposed height be increased from 48 to 50′ above extreme h. w., **88**, 2465.

MISSOURI R., Nebraska City, Nebr. (Sp.) (City.) LEGISLATION.—Au. by act July 16, 1888. PLANS.—Plan and location submitted, and approv. by Sec. of War Apr. 3, 1890, **90**, 337.

MISSOURI R., Omaha, Nebr. (Sp.) (Railway.) LEGISLATION.—Br. au. by act Feb. 24, 1871, under provisions of act July 25, 1866, **78**, 1090. PLANS.—Description of br. by Maj. Warren, **78**, 1087.

MISSOURI R., between Omaha and Council Bluffs. (Sp.) (Omaha & Council Bluffs R. R. & Br. Co., railway and wagon.) **88**, 309. LEGISLATION.—Br. au. by act Mar. 3, 1887, **88**, 2467. PLANS.—Maj. Raymond **R.** br. as proposed would not interfere with the existing requirements of navigation, **88**, 2469.

MISSOURI R., Omaha, Nebr. (Sp.) (Nebraska Central R. R. Co.) LEGISLATION.—Au. by act June 22, 1888. PLANS.—Plan and location submitted, and approv. by Sec. of War Feb. 27, 1890, **90**, 337.

MISSOURI R., Pierre, S. Dak. (Sp.) (Pierre & Fort Pierre Br. Ry. Co.) Au. act May 17, 1886. PLANS.—Approv. July 14, 1907, **07**, 816.

MISSOURI R., Plattsmouth, Nebr. (S.) (Chicago, Burlington & Quincy R. R. Co.) PLANS.—Reconstr. approv. Nov. 5, 1901, **02**, 586.

MISSOURI R., near Quindaro, Kans., about 8.6 m. above Hannibal & St. Joseph R. R. br. at Kansas City. (Sp.) (Kansas City Terminal Ry. Co.) LEGISLATION.—Company au. to constr. br. by act Mar. 1, 1889; amending act June 28, 1890. PLANS.—Approv. Dec. 1, 1890, **91**, 430.

MISSOURI R., St. Charles, Mo. (Railway.) PLANS.—Description of br. by Maj. Warren. Cost of, $1,797,186.19. **78**, 1087.

MISSOURI R., St. Charles, Mo. (Sp.) (Occidental Br. & Construction Co.) LEGISLATION.—Constr. au. by act May 23, 1892. PLANS.—Submitted Feb. 21, 1893; modified Apr. 11, 1893; approv. Apr. 29, 1893, **93**, 465.

MISSOURI R., St. Charles, Mo. (Sp.) (St. Charles & St. Louis County Br. Co.) LEGISLATION.—Counties au. to constr. br. by act June 3, 1896, amending acts May 28, 1898, and Jan. 27, 1900. PLANS.—Approv. June 27, 1900, **00**, 698.

MISSOURI R., St. Joseph, Mo. (Sp.) (Rail and high way.) LEGISLATION.—Br. au. acts July 20, 1868; July 14, 1870; and Mar. 5, 1872, **78**, 1089, 1090, 1091. PLANS.—Description of br. by Maj. Warren, **78**, 1087.

MISSOURI R., most accessible point between Sibley and Kansas City, Mo. (Sp.) (Kansas City & Atlantic R. R. Co., successors to the Chicago, Kansas City & Texas Ry. Co.) ENGINEERS.—Chief of Engineers. **R.**, **89**, 370; **96**, 422; **99**, 619. LEGISLATION.—Orig. company au. to constr. br. by act Mar. 3, 1887, **89**, 370. Owners received au. from same act, as extended by act Mar. 29, 1894, **96**, 422. PLANS.—Orig. company's plans approv. Feb. 14, 1889; br. partly constr., **89**, 370. Owner's new plans approv. Dec. 17, 1895, **96**, 422. Modified plans, for a draw span instead of a lifting span, approv. Apr. 28, 1899, **99**, 619.

MISSOURI R., Sibley, Mo. (Sp.) (Kansas City, Topeka & Western R. R. Co.) **88**, 308, 2435. LEGISLATION.—Br. au. by act July 3, 1884, **88**, 2434. PLANS.—In 1887 Lt. Col. Suter **R.** that the br. would not form any obstr. to navigation, **88**, 2436.

MISSOURI R., at or near Sibley, Mo. (Sp.) (Atchison, Topeka & Santa Fe Ry. Co.) Au. acts Mar. 23, 1910, and Jan. 22, 1912. PLANS.—Approv. Dec. 19, 1910, **11**, 1080. Reconstr. approv. Mar. 8, 1912, **12**, 1297.

MISSOURI R., Sioux City, Iowa. (Sp.) (Sioux City & Pacific R. R. Co.) LEGISLATION.—Br. au. by act Aug. 15, 1876, **78**, 1094. Br. au. by act June 27, 1882, **83**, 271. PLANS.—Maj. Suter **R.** if the br. be located and built as proj. it would form no unnecessary obstr. to navigation, **83**, 1603.

MISSOURI R., Sioux City, Iowa. (Sp.) (Sioux City Br. Co.) **88**, 309. LEGISLATION.—Br. au. by act Aug. 15, 1886, **88**, 2477. PLANS.—Dimensions of proposed br., **88**, 2476. Lt. Col. Suter **R.** the proposed span of 400′, with a treadway of 50′, amply sufficient for the requirements of navigation, **88**, 2477.

MISSOURI R., Sioux City, Iowa. (Sp.) (Pacific Short Line Br. Co.) LEGISLATION.—Au. by act Mar. 2, 1889. PLANS.—Plan and location submitted, and approv. by Sec. of War, June 26, 1890, 90, 338.

MISSOURI R., South Omaha, Nebr. (Sp.) (South Omaha R. R. & Br. Co.) Au. act Mar. 26, 1902. PLANS.—Approv. Apr. 8, 1904, 04, 711, 712.

MISSOURI R., between Walworth and Dewey Counties, S. Dak. (Sp.) (Chicago, Milwaukee & St. Paul Ry. Co.) Au. act Apr. 12, 1906. PLANS.—Approv. Aug. 3, 1906, 07, 817.

MISSOURI R., near mouth of Kansas R., between Wyandotte County, Kans., and Clay County, Mo. (Sp.) (Missouri River & Land Imp. & Construction Co.) LEGISLATION.—Company au. to constr. br. by acts Oct. 12, 1888, and Feb. 6, 1890, 91, 432. PLANS.—Submitted Oct. 12, 1889; not conforming to the act Oct. 12, 1888, were not approv. Plans submitted Feb. 7, 1890, and Jan. 24, 1891; R. upon adversely by the Missouri R. Commission; not approv. Amended plans submitted Mar. 2, 1891; approv. June 4, 1891. 91, 432.

MISSOURI R., Yankton, S. Dak. (Sp.) (Yankton Br. Co.) LEGISLATION.—Company au. to constr. br. by act June 22, 1892; amending act May 28, 1894, 94, 425. PLANS.—Approv. Aug. 3, 1894, 94, 425. Subsequently plans for lengthening of 2 n. end main spans approv. Sept. 11, 1896. Plans in lieu of the last approv. Nov. 23, 1896. 97, 529.

MISSOURI R., Yankton, S. Dak. (Sp.) (Yankton, Norfolk & Southern Ry. Co.) Au. act Mar. 9, 1904. PLANS.—Approv. Aug. 23, 1904, 05, 720.

MOBILE B., Cedar Pt. to Dauphin Isld., Ala. (Sp.) (Mobile Ry. & Dock Co.) Au. act Feb. 5, 1906. PLANS.—Approv. Feb. 23, 1907, 07, 818.

MOBILE B. and **MISSISSIPPI SOUND,** across shoal water between, Cedar Pt. to Dauphin Isld., Ala. (Sp.) (Mobile & Dauphin R. R. & Harbor Co.) LEGISLATION.—Constr. au. by act Sept. 26, 1890; amending act Feb. 28, 1893. PLANS.—Submitted Sept. 10, 1892; approv. Aug. 21, 1893, 93, 465.

MOBILE COUNTY, between Cedar Pt. and Big Dauphin Isld., Ala. (Sp.) (Dauphin Island Ry. & Harbor Co.) Au. act June 25, 1910. PLANS.—Constr. of brs. and trestles approv. Apr. 17, 1911, 11, 1080.

MOBILE R., Ala. (Dr.) 08, 865.

MOCCASIN R. (Contentnia Creek), Hookertown, N. C. (S.) (Green County br.) PLANS.—Br. to replace existing str. approv. June 1, 1908, 08, 872.

MOCCASIN R. (Contentnia Creek), Grifton, N. C. (S.) (Pitt County br.) PLANS.—Approv. Nov. 26, 1907, 08, 871.

MOHAWK R., Schnectady County, N. Y. (S.) (Schenectady Ry. Co.) PLANS.—Approv. July 20, 1903, 04, 713.

MOKELUMNE R., Cal. (S.) (Western Pacific Ry. Co.) PLANS.—Approv. Jan. 13, 1906, 06, 803.

MOKELUMNE R., Benson Ferry, Cal. (S.) (San Joaquin County br.) PLANS.—Approv. June 23, 1909, 09, 918.

MOKELUMNE R., near mouth of Snodgrass Slough, Cal. (S.) (Sacramento and San Joaquin Counties' br.) PLANS.—Approv. Aug. 25, 1902, 03, 646.

MOKELUMNE R., S. Fork, New Hope Landing, Cal. (S.) (San Joaquin County, Cal.) PLANS.—Approv. Mar. 24, 1893. Completion of br. R. on June 30, 1893. 93, 469.

MONONGAHELA R. (See Ohio R., etc.)

MONONGAHELA R., Pa. (Sp.) (Br. of Allegheny and Washington Counties.) Au. act Apr. 3, 1908. PLANS.—Approv. May 21, 1908, and July 5, 1908, 08, 868; 09, 912.

MONONGAHELA, Allegheny, and at the lower end of the Muskingum Rs. (A.) 88, 2566. PLANS.—Tabular statement of all brs., with dimensions thereof, over the navigable portions of the Monongahela and Allegheny Rs., 88, 2566, 2568. Brs. on the Monongahela and Allegheny requiring modification, 88, 2567, 2569.

MONONGAHELA R., between Braddock and Mifflin Townships, Pa. (Sp.) (Braddock & Duquesne Br. Co.) LEGISLATION.—Company au. to constr. br. by act Jan. 26, 1897. PLANS.—Approv. Apr. 10, 1897, 97, 530.

MONONGAHELA R., Bridge Street, Bridgeport, Pa. (O.) (Monongahela Br. Co.—Brownsville br.) PLANS.—Alterations to be completed on or before Aug. 1, 1905, 05, 729.

MONONGAHELA R., Clairton Station, Pa. (Sp.) (St. Clair Terminal R. R. Co.) Au. act Mar. 10, 1902. PLANS.—Approv. Mar. 26, 1902, 02, 582.

MONONGAHELA R., near Denora and Webster, Pa. (Sp.) (Br. of Westmoreland and Washington Counties, Pa.) PLANS.—Constr. au. by act Feb. 21, 1903, as amended by act Jan. 11, 1905. Plans approv. Nov. 2, 1905. 06, 799.

MONONGAHELA R., Elizabeth, Pa. (Sp.) West Elizabeth Br. Co.) LEGISLATION.—Company au. to constr. br. by act Feb. 15, 1893. PLANS.—Submitted June 17, 1892; modified Aug. 25, 1892, and Feb. 28, 1893; approv. Mar. 18, 1893, 93, 464.

MONONGAHELA R., near Fairmont, W. Va. 85, 293, 1923. PLANS.—Referred to Lt. Col. Merrill for ex. and R., 85, 293, 1920. Recom. that site and plans be approv., provided that 1 chan. span be arranged with opening of 220′ and a clear height of 41½′, 85, 1922. Clear span reduced to 140′, 85, 1924; and the recom. mead and approv. by Sec. of War that the br. company be permitted to build at a less height than that above indicated, provided they should subsequently raise the br. if required, 85, 1924.

MONONGAHELA R., Fairmont, Marion County, W. Va. (A.) (Marion County br.) PLANS.—Reconstr. approv. May 26, 1903, 03, 651.

MONONGAHELA R., 1½ m. below Fairmont, W. Va. (O.) (Fairmont, Morgantown & Pittsburg R. R. Co., and the Baltimore & Ohio R. R.

Co.) PLANS.—Alterations to be completed on or before Aug. 1, 1905, **05**, 729.

MONONGAHELA R., 1½ m. below Fairmont, W. Va. (A.) (Baltimore & Ohio R. R. Co., and the Fairmont, Morgantown & Pittsburg R. R. Co.) PLANS.—New br. at a different location to replace existing str., approv. Mar. 15, 1905, **05**, 729.

MONONGAHELA R., between Fayette and Green Counties, near Geneva, Pa. (Sp.) (Monongahela R. R. Co.) Au. act May 3, 1911. PLANS.—Approv. May 31 and modified plans approv. Oct. 7, 1911, and former plans canceled, **12**, 1296.

MONONGAHELA R., 1 m. above New Geneva, Pa. (Sp.) (Monongahela R. R. Co.) Au. act Jan. 27, 1910. PLANS.—Approv. May 3, 1911, and modified plans approv. May 31, 1911, **11**, 1081.

MONONGAHELA R., between Homestead and Pittsburgh, Pa. (Sp.) (Braddock & Homestead Br. Co.) LEGISLATION.—Company au. to constr. br. by act June 7, 1894. PLANS.—Submitted July 26, 1894, proved unsatisfactory to navigation interests; modified plans approv. Sept. 20, 1894, **95**, 473.

MONONGAHELA R., at McCanns Ferry, Pa. (Sp.) (Leckrone & Little Whiteley R. R. Co.) Au. act Feb. 16, 1905. PLANS.—Approv. June 12, 1905, **05**, 722. Plans in lieu thereof approv. Jan. 22, 1906, **06**, 799.

MONONGAHELA R., McKeesport, Pa. (Sp.) (Mifflin Br. Co.) LEGISLATION.—Company au. to constr. br. by act Feb. 25, 1897. PLANS.—Modified plans approv. Feb. 24, 1898, **98**, 531.

MONONGAHELA R., between Mifflin and Rankin, Pa. (at Carrie Furnaces). (Sp.) (Union R. R. Co.) LEGISLATION.—Company au. to constr. br. by act Mar. 2, 1900. PLANS.—Approv. Mar. 10, 1900, **00**, 697.

MONONGAHELA R., Monongahela City, Pa. (Sp.) (Pittsburgh, Monongahela & Wheeling R. R. Co.) LEGISLATION.—Company au. to constr. br. by act Mar. 2, 1895. PLANS.—Approv. Sept. 12, 1895, **96**, 422.

MONONGAHELA R., Monongahela, Pa. (O.) (Williamsport Br. Co., and Washington and Allegheny Counties, Pa.) PLANS.—Alterations to be completed on or before 2 years from Oct. 15, 1906, **07**, 828.

MONONGAHELA R., Morgantown, W. Va. (A.) (Monongahela County br.) PLANS.—Reconstr. approv. Dec. 26, 1905, **06**, 808.

MONONGAHELA R., Pleasant Street, Morgantown, W. Va. (A.) (Monongahela County br.) PLANS.—Rebuilding approv. Dec. 26, 1905. Modified plans in lieu thereof approv. July 11, 1907. **08**, 873.

MONONGAHELA R., North Charleroi, Pa. (Sp.) (Charleroi & Monessen Br. Co.) Au. act Mar. 3, 1901. PLANS.—Approv. Dec. 18, 1901, **02**, 582.

MONONGAHELA R., North Charleroi, above Dam No. 4, Pittsburgh H., Pa. (Sp.) (Mercantile Br. Co.) PLANS.—Constr. approv. Aug. 8, 1904. Plans in lieu thereof approv. Aug. 2, 1905. **06**, 798, 799.

MONONGAHELA R., near Ferry Street, Pittsburgh, Pa. (Sp.) (Pittsburg & Mansfield R. R. Co.) LEGISLATION.—Company au. to constr. br. by act Mar. 2, 1895. PLANS.—Approv. May 20, 1896, **96**, 423. Modified plans involving slight change in line of br., location, and size of ps., approv. July 17, 1901, **02**, 581.

MONONGAHELA R., Pittsburgh, Pa. (Sp.) (Glenwood Highway Br. Co.) LEGISLATION.—Company au. to constr. br. by act Apr. 2, 1894. PLANS.—Approv. Nov. 3, 1894; reported completed, **95**, 474.

MONONGAHELA R., S. 10th Street, Pittsburgh, Pa. (S.) (Birmingham & Pittsburgh Br. Co.) PLANS.—Reconstr. of br. submitted July 20, 1894; unsatisfactory to navigation interests; modified plans approv. Oct. 22, 1894, **95**, 477.

MONONGAHELA R., S. 22d Street, Pittsburgh, Pa. (Sp.) (Pittsburgh city br.) LEGISLATION.—City au. to constr. br. by act May 7, 1894. PLANS.—Submitted May 29, 1894; modified Aug. 3, 1894; approv. Aug. 21, 1894, **94**, 426.

MONONGAHELA R., Pittsburgh, Pa. (Sp., etc.) (S. 22d Street Br. Co.) LEGISLATION.—Company au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Pennsylvania. PLANS.—Modified plan approv. Dec. 26, 1891, **92**, 403.

MONONGAHELA R., near Pittsburgh, Pa. (Sp.) (The Upper Br. Co.) LEGISLATION.—Company au. to constr. br. under act Sept. 19, sec. 7, and act of Pennsylvania. PLANS.—Modified plans approv. Aug. 21, 1891, **91**, 432.

MONONGAHELA R., near 30th Street, s. side, Pittsburgh, Pa. (S.) (Monongahela Connecting R. R. Co.) PLANS.—An addl. span for a Y to the existing br. approv. Apr. 9, 1898, **98**, 535.

MONONGAHELA R., Pittsburgh, Pa. (S.) (Pennsylvania Co.) PLANS.—Reconstr. of existing br. approv. Aug. 19, 1901, **02**, 584.

MONONGAHELA R., Pittsburgh, Pa. (Sp.) (Monongahela Connecting R. R. Co.) Au. act June 28, 1906. PLANS.—Approv. June 11, 1907, **07**, 819.

MONONGAHELA R., above Dam No. 4, Pittsburgh H., Pa. (Sp.) (Mercantile Br. Co.) Au. act Mar. 14, 1904. PLANS.—Approv. Aug. 8, 1904, **05**, 720.

MONONGAHELA R., S. 10th Street, Pittsburgh, Pa. (S.) (City br.) PLANS.—Reconstr. approv. Aug. 29, 1900, **01**, 662. Repairs to s. p. approv. June 10, 1912, **12**, 1308.

MONONGAHELA R., between Pittsburgh and Homestead, Pa. (Sp.) (Homestead & Pittsburgh Br. Co.) LEGISLATION.—Constr. au. by act Feb. 14, 1893. PLANS.—Modified plans approv. May 24, 1893, **93**, 465.

MONONGAHELA R., Port Perry, Pa. (S.) (Pennsylvania R. R. Co.) PLANS.—Rebuilding approv. June 25, 1902, **02**, 589.

MONONGAHELA R., between Port Perry and Mifflin Townships, Pa. (Sp.) (Union R. R. Co.) LEGISLATION.—Company au. to constr. br. by act Jan. 26, 1897. PLANS.—For br. in lieu of those approv. Oct. 2, 1896, for br. between Mifflin and Wilkins Townships, submitted Jan. 30, 1897; modified Feb. 23, 1897; approv. Mar. 8, 1897, **97,** 529.

MONONGAHELA R., Port Vue to Jefferson, Pa. (Sp.) (Glassport Br. Co.) Au. act Feb. 18, 1901. PLANS.—Approv. June 18, 1901, **01,** 661.

MONONGAHELA R., Rankin, Pa. (Sp.) (West Braddock Br. Co.) LEGISLATION.—Company au. to constr. br. by act Apr. 21, 1894, **96,** 424. PLANS.—Approv. July 20, 1896, **96,** 424. Specified modified plans submitted Dec. 3, 1896; approv. Dec. 21, 1896, **97,** 533.

MONONGAHELA R., Rivesville, W. Va. (Sp.) (Buckhannon & Northern R. R. Co.) Au. act Apr. 5, 1904. PLANS.—Approv. Apr. 14, 1904, **04,** 712.

MONONGAHELA R., Rostraver Township, Pa. (Sp.) (Charleroi & Monessen Br. Co.) Au. acts Mar. 3, 1901, and Mar. 14, 1904. PLANS.—Approv. Dec. 18, 1901, **02,** 582. Time limit prescribed by the act having expired before constr. was commenced, and the orig. act having been revived and reenacted, the plans were approv. Apr. 12, 1905, **04,** 712.

MONTEZUMA SLOUGH, tributary of Suisun B., Cal. (S.) (Oakland, Antioch & Eastern Ry. Co.) PLANS.—Approv. June 17, 1912, **12,** 1308.

MONUMENT R., Mass. (S.) (New York, New Haven & Hartford R. R. Co.) PLANS.—Reconstr. approv. Aug. 5, 1909, and modified plans approv. Nov. 30, 1909, **10,** 1023.

MONUMENT and **BLACK RS.,** Bourne, Mass. (S.) (Town br.) PLANS.—Approv. July 3, 1897, **97,** 534.

MORMON CHAN., Stockton, Cal. (S.) (San Francisco & San Joaquin Valley R. R. Co.) PLANS.—Approv. Sept. 10, 1895, **96,** 424.

MORMON CHAN., Otter Street, Stockton, Cal. (S.) (City br.) PLANS.—Approv. Sept. 17, 1894. Plans changing the location approv. Jan. 7, 1895. Br. completed. **95,** 476.

MORMON CHAN., Stockton, Cal. (S.) (Southern Pacific Co.) PLANS.—Approv. Feb. 3, 1903, **03,** 648.

MORRIS AND CUMMINGS CHAN., near Stedman Isld., Tex. (Sp.) (Aransas Harbor Terminal Ry.) Au. act Jan. 22, 1912. PLANS.—Approv. Feb. 9, 1912, **12,** 1297.

MORRISON CHAN., between Benton H. and St. Joseph, Mich. (S.) (Michigan Central R. R. Co.) PLANS.—Rebuilding approv. Apr. 20, 1906, **06,** 806.

MORRISON CHAN., at St. Joseph, Mich. (Sp.) (City br.) Act Mar. 23, 1910. PLANS.—Temporary br. approv. Feb. 28, 1910. Modified plans of temporary br. approv. Mar. 24, 1910. Plans of permanent br. approv. Apr. 20, 1910. **10,** 1021, 1022.

MORSE and **SPRAGUE RS.,** Phippsburg, Me. (S.) (Town brs.) PLANS.—Approv. Jan. 18, 1899, **99,** 621.

MOUNT DESERT NARROWS, between Trenton and Eden, Me. (S.) (Mount Desert Transit Co.) PLANS.—Approv. Jan. 25, 1909, **09,** 917.

MOUNT PLEASANT and **SULLIVANS ISLD.,** cove between, S. C. (S.) (Charleston Sea Shore R. R. Co.) PLANS.—Approv. June 7, 1898, **98,** 536.

MUD R., at or near Rochester, Ky. (S.) (Butler & Muhlenburg Counties' br.) PLANS.—Approv. Oct. 2, 1897, **98,** 533.

MURDERERS (Moodna) CREEK, near mouth, Cornwall, Orange County, N. Y. (O.) (R. R. br.) LEGISLATION.—As the R. R. company failed to comply with requirements of notice, the Atty. Gen. of U. S. was requested, July 23, 1889, to take action as prescribed by law. PLANS.—Alterations required by July 1, 1889; no action taken, **89,** 377.

MURDERERS CREEK, N. Y. (O.) LEGISLATION.—Notice served as to alterations required, **90,** 342.

MUSKEGON LAKE, Mich. (S.) (North Muskegon br.) PLANS.—Submitted Feb. 15, 1892; approv. Mar. 1, 1893, **93,** 468.

MUSKEGON R., Muskegon, Mich. (S.) (City br.) PLANS.—Submitted Feb. 19, 1892; approv, Mar. 11, 1893, **93,** 468.

MUSKEGON R., Muskegon County, Mich. (S.) (Muskegon County br.) PLANS.—Approv. Sept. 18, 1908, **09,** 915.

MUSKINGUM R. (See Monongahela R.; Ohio R., etc.)

MUSKINGUM R., Ohio. (O.) LEGISLATION.—Notice served as to alterations required, **90,** 341.

MUSKINGUM R., between Beverly and Waterford, Ohio. (O.) (County br.) PLANS.—Alterations required by Sept. 30, 1889, **89,** 376.

MUSKINGUM R., below Dresden, Ohio. (O.) (Cincinnati & Muskingum Valley R. R. Co.) PLANS.—Alterations to be completed on or before 14 months from June 27, 1908, **08,** 874.

MUSKINGUM R., Gaysport, Ohio. (O.) (Muskingum County br.) PLANS.—Alterations to be completed on or before Jan. 1, 1905, **04,** 720.

MUSKINGUM R., Marietta, Ohio. (Sp.) (City br.) LEGISLATION.—City au. to constr. br. under act Apr. 2, 1888. PLANS.—Public hearing held; plans approv. Aug. 11, 1899, **99,** 620.

MUSKINGUM R., Marietta, Ohio. (A.) (Baltimore & Ohio Southwestern R. R. Co.) PLANS.—Proceedings instituted against the company, under act Aug. 11, 1888 (amending act Sept. 19, 1890), requiring a suitable drawspan opening. Company failed to alter br.; alteration required to be completed by Oct. 31, 1891; time extended to July 1, 1892; order revoked Feb. 6, 1893. Act Aug. 17, 1894, required changes, to be paid by the U. S. In accordance

therewith Col. Stickney submitted plans for pivot p.; approv. June 4, 1895; superstr. of the draw to be completed by the railway company. **95,** 481. (See Muskingum R., Ice H. at mouth of, **96,** 277.)

MUSKINGUM R., between Marietta and Harmar, Ohio. (O.) (Baltimore & Ohio Southwestern R. R. Co.) PLANS.—Specified alterations required on or before Oct. 31, 1891; time extended to Jan. 1, 1892, **91,** 434.

MUSKINGUM R., Muskingum, Mich. (S.) (City br.) PLANS.—Submitted Feb. 19, 1892; approv. Mar. 11, 1893, **93,** 468.

MUSKINGUM R., McConnelsville to Malta, Ohio.) (S.) (Morgan County br.) PLANS.—Reconstr. approv. May 29, 1901, **01,** 666.

MUSKINGUM R., over Lowell Canal, Ohio. (O.) (County br.) PLANS.—Alterations required by Nov. 1, 1889, **89,** 377.

MUSKINGUM R. CANAL, Lowell Ohio. (Sp.) (Washington County br.) Au. act Apr. 2, 1888. PLANS.—Approv. May 28, 1901, **01,** 660.

MUSKINGUM R., Stockport, Ohio. (Sp.) (Morgan County br.) LEGISLATION.—County au. to constr. br. by act Apr. 2, 1888. PLANS.—Approv. Aug. 14, 1888. On June 3, 1899, it was discovered that the pivot p. of the draw span had been located 10′ w. of position in the approv. drawings; the adopted location approv. June 15, 1889, **89,** 372.

MUSKINGUM R., Taylorsville, Ohio. (A.) (Muskingum County br.) PLANS.—In Jan., 1890, br. a probable obstr. upon completion of Lock No. 9, at Taylorsville; under act Aug. 11, 1890, notices were served for a suitable draw span to be completed by Sept. 30, 1891. Legal proceedings were instituted against the commissioners, which resulted in a verdict for defendant. **91,** 434; **92,** 2004, 2006. Act Aug. 17, 1894, required changes to be made to conform to the accommodation of C. and imp. of the R., using public funds; superstr. of the draw to be built by the county commissioners. **95,** 482. Lt. Col. Stickney submitted plans for pivot p. and guide cribs; approv. June 12, 1895, **95,** 482. (See Muskingum R., lock at Taylorsville, Ohio, **96,** 277.)

MUSKINGUM R., Zanesville, Ohio. (Sp.) (County.) LEGISLATION.—Au. by act Apr. 2, 1888. PLANS.—Plans and location submitted, and approv. by Sec. of War, Aug. 5, 1889, **90,** 336.

MUSKINGUM R., canal at foot of Main Street, Zanesville, Ohio. (O.) (Muskingum County br.) PLANS.—Specified alterations required on or before Dec. 1, 1891; time extended to Dec. 1, 1892, to be then further extended or abandoned if U. S. work of constr. l. and d. No. 11 be not commenced, **91,** 434.

MUSKINGUM R., over canal at Zanesville, Ohio. (Muskingum County br.) PLANS.—Alterations required by Nov. 1, 1889, **89,** 377.

MUSKINGUM R., 5th Street, Zanesville, Ohio. (O. and Sp.) (Muskingum County br.) PLANS.—Alterations required by Nov. 1, 1889, **89,** 377. Reconstr. approv. Sept. 23, 1910, **11,** 1079, 1080.

MUSKINGUM R. (Y br.), Zanesville, Ohio. (Sp.) (Muskingum County br.) Au. act Apr. 2, 1888. PLANS.—Approv. Aug. 18, 1900, **01,** 659.

MUSKINGUM R., 5th Street, Zanesville, Ohio. (Sp.) (Muskingum County br.) Au. Apr. 2, 1888. PLANS.—Reconstr. approv. Sept. 23, 1910, **11,** 1079, 1080.

MUSKINGUM R. (lateral canal along), Zanesville, Ohio. (S.) (Muskingum County br.) PLANS.—Approv. June 18, 1901, **01,** 667.

MUSKINGUM R. CANAL, Zanesville, Ohio. (Sp.) (Baltimore & Ohio R. R. Co.) Au. act Apr. 2, 1888. PLANS.—Reconstr. plans approv. Apr. 8, 1911, **11,** 1080.

MYAKKA R., Fla. (S.) (Alafia, Manatee & Gulf Coast Ry. Co.) PLANS.—Approv. June 9, 1906, **06,** 807.

MYSTIC R., Boston, Mass. (Dr.) **06,** 797.

MYSTIC R. (Malden br.), Boston, Mass. (S.) (City br.) PLANS.—Reconstr. plans approv. Aug. 12, 1899, **99,** 623. Plans for temporary br., during constr. of permanent br., approv. Nov. 4, 1899; alternate plans submitted Jan. 13, 1900; approv. Jan. 30, 1900, **00,** 700.

MYSTIC R., between Boston and Chelsea (Chelsea Br.), Mass. (S.) (Boston city br.) PLANS.—For reconstr. of draw span approv. May 4, 1895, **95,** 478. Reconstr. plans for the draw, and plans for a temporary br. for use during reconstr. of permanent br., approv. Sept. 7, 1899. Plans for n. extension of draw p. approv. June 29, 1900. **00,** 698. Temporary br. during reconstr. of existing br. approv. Sept. 3, 1910, **11,** 1083.

MYSTIC R., Boston, Mass. (S.) (Lynn & Boston R. R. Co., temporary br.) PLANS.—Temporary br. approv. May 21, 1895, **95,** 478. Approv. Apr. 13, 1893, **93,** 469.

MYSTIC R., Conn. (Dr.) **08,** 865.

MYSTIC R., Mass. (Dr.) **02,** 581; **03,** 642.

MYSTIC R., Boston H., Mass. (O.) (Br. of the cities of Boston and Chelsea.) PLANS.—Alterations to be completed on or before June 30, 1911, **10,** 1032. Plans for temporary br. approv. Sept. 3, 1910, and time of completion of alterations extended to Dec. 31, 1911, **11,** 1090, 1091.

MYSTIC R. (main or n. chan.), Boston, Mass. (S.) (City br.) PLANS.—Reconstr. of existing br. approv. Dec. 5, 1911, in lieu of alterations required by War Dept., June 3, 1910, and instrument of approv. for temporary br., dated Sept. 3, 1910, revoked **12,** 1303.

MYSTIC R., Medford, Mass. (S.) (State br.) PLANS.—Approv. June 22, 1906, **06,** 808.

MYSTIC R., between Somerville and Medford, Mass. (S.) (State br.) PLANS.—Approv. May 29, 1902, **02,** 589.

MYSTIC R., Stonington, Conn. (S.) (Br. of Groton and Stonington Townships.) PLANS.—Rebuilding existing br. and constr. of temporary br. approv. Feb. 5, 1904, **04,** 716.

N.

NANSEMOND R., Va. (See Elizabeth R.)

NANTICOKE R., W. Fork, Federalsburg, Md. (S.) (Philadelphia, Baltimore & Washington R. R. Co.) PLANS.—Reconstr. approv. Feb. 23, 1906, **06,** 804.

NANTICOKE R., Sharpstown, Md. (S.) (State br.) PLANS.—Approv. May 11, 1911, **11,** 1089.

NAPA R., Napa, Cal. (Sp., etc.) (City br.) LEGISLATION.—City au. to constr. br. under act July 13, 1892, sec. 3, and act of California. PLANS.—New br. approv. Sept. 6, 1892, **92,** 410.

NAPA R., Napa Junction, Cal. (S.) (Southern Pacific R. R. Co.) PLANS.—Reconstr. approv. Dec. 3, 1901, **02,** 586.

NAPA R., near Napa Junction, Cal. (O.) (Southern Pacific Co.) PLANS.—Alterations to be made and completed within 60 days from Oct. 23, 1911, **12,** 1309.

NARRAGANSETT B. (See Bullocks Cove.)

NASEL R., Wash. (S.) (Pacific County br.) PLANS.—Approv. Aug. 16, 1907, **08,** 869.

NARRAGUAGUS R., Milbridge, Me. (Sp., etc.) (Town br.) LEGISLATION.—Town au. to alter br. under act Sept. 19, 1890. PLANS.—Alteration plans for the "Great Bridge" approv. July 7, 1892, **92,** 407.

NARROW B., from Mucachogue, Great South Beach, to Smiths Pt., N. Y. (S.) (Tangier's Manors' Corp.) PLANS.—Approv. Nov. 10, 1910, **11,** 1084.

NASSAU R., Fla., on the Duval and Fernandina Road, Fla. (S.) (Br. of Nassau and Duval Counties.) PLANS.—Approv. Aug. 17, 1911, **12,** 1300.

NAVIGABLE WATERS OF THE UNITED STATES, BRIDGING. (See also Topical Index.) COMMERCE.—List of brs., and of brs. au. over the Mississippi R., **73,** 575. List of apps. for Rs. and Hs. in Mississippi Valley, and for all Rs. and Hs., **73,** 576. All brs. are obstrs., **74,** 585. Right of way belongs to navigation, and draws should stand open when not in use, **74,** 586. Agriculture the only industry not protected by the U. S., but rather injured by the overproduction stimulated by the homestead land policy; the only help is cheap transportation, **74,** 608. General requirements of western R. navigation, **78,** 926. Statement of losses by collision with the ps. of brs. on the Ohio R., **71,** 429. Signals at draws, plan for, **73,** 583; **78,** 723; objections to, **73,** 585. Power of Congress to protect, **82,** 1980. List of brs. on Upper Mississippi which impede C., **82,** 1981. Importance of coal interests on the Ohio R. and the requirements of its C., **82,** 2005. Obstr. to navigation on Chippewa R., Wis., from existing brs., **82,** 1811. Dimensions of coal and grain tows on the Mississippi R., **88,** 2380, 2381. Testimony before the board in regard to dimensions of tows and desirable dimensions of chan. spans, **88,** 2397, 2398, 2400, 2404, 2406, 2408, 2409, 2410. ENGINEERS.—Chief of Engineers **Rs., 88,** 307, 2371; **00,** 40. BE. **R.** of 1888, relative to constr. of certain brs. across the Missouri, Mississippi, and Illinois Rs. **Rs., 88,** 2374 (Lt. Col. Suter, and Majs. Mackenzie, Miller, and Handbury); **88,** 2383 (Lt. Col. Suter and Maj. Miller). Constituted by S. O. No. 7, Feb. 3, 1900, to consider and **R.** upon the House bill 1065, 56th Cong. 1st sess., "to authorize the constr. of brs. across the Ohio, Monongahela, Mississippi, Great Kanawha, Tennessee, Cumberland, and Illinois Rs., and prescribe the dimensions of the same." **R., 00,** 5103. (Lt. Col. M. B. Adams, Majs. C. F. Powell, J. H. Willard, W. H. Bixby, and D. C. Kingman; and Capts. H. F. Hodges and E. Burr.) GENERAL CONSIDERATIONS.—Object, to secure interests of navigation, **73,** 559. Number of brs. can not be limited, nor their details controlled, except as regards needs of navigation, **73,** 559. Drawbrs. *v.* h. brs. discussed by Maj. Warren, **73,** 560. General subjects of concession to R. Rs. discussed by BE., **73,** 574. Bad results to navigation from legislation, such as that au. br. at Kansas City, discussed by Capt. Suter, **69,** 306. Discussion of the greatest length of span practicable, by Maj. Warren, **78,** 1063, 1065. Names and dimensions of the largest boats on the Mississippi R., **78,** 929. Discussion on headway required under brs. on the Mississippi R., **78,** 934. Grades and curvatures upon brs. and approaches, **79,** 149, 1461. Maj. Warren's **R.** on br. the Mississippi R., **78,** 900–1125. List of brs. au. on the Missouri R. but not built, **78,** 1088. List of brs. on the Ohio, **78,** 1086. List of brs. on the Mississippi R. from St. Paul, Minn., to St. Louis, Mo., **78,** 1028. Of navigation through brs. over Upper Mississippi R., **82,** 1979. Power of Congress to protect navigation, **82,** 1980. Necessity for changes in laws relating to brs. across the Ohio R., **82,** 1813, 2002. General considerations at special localities, **80,** 199, 1849; **81,** 267, 2009; **82,** 262, 1989; **83,** 271, 1591; **84,** 269 1769; **85,** 292, 1917; **86,** 369, 2111; **87,** 337, 2613. LEGISLATION (see BE.).—By Wisconsin and Minnesota au. brs. over navigable part of Wisconsin, Mississippi, and Minnesota Rs., **73,** 558 No au. from Congress for 3 brs. over the Mississippi at Hastings and St. Paul, **73,** 568. Au. of Congress required before War Dept. can au. or forbid the constr. of a br., **76,** ii, 298. Passage for highways to be a part of all brs. built after act

June 4, 1872, **73**, 565, 569; not so considered by Atty. Gen., **73**, 570. Abstracts of debates in Congress attending the legalization of brs. across the Mississippi R., **78**, 1041. Decisions of U. S. Supreme Court relating to damages, **78**, 1079. Riprap considered as an obstr. to navigation on the Ohio, H. Doc. 41, 43d Cong., 2d sess. Amendment of existing laws proposed by BE. for constr. of brs. over the Ohio, **71**, 454, 455. Act of Congress, July 11, 1870, constituting BE. for ex. of brs. on the Ohio, **71**, 426. Abstract of laws for br. the Ohio, Mississippi, and Missouri Rs., **78**, 1068. Acts of Congress: Act July 25, 1866, partially described, **69**, 309; described, **73**, 555; compared in full with act Apr. 1, 1872, **73**, 561. Act Feb. 21, 1868, described, **73**, 555. Act Apr. 1, 1872, described, **73**, 555; compared in full with act July 25, 1866, **73**, 561. Act June 4, 1872, **73**, 563. Necessity of legislation relating to brs. over the Upper Mississippi R., **82**, 1979. Consideration of a proposed act to prescribe the dimensions of brs. across the Ohio R., **82**, 2001. Defects in present laws relating to brs. across the Ohio R., **82**, 2008. Amendatory act proposed for Ohio R., **82**, 2010. Necessity for general law applying to brs. over navigable waters, **82**, 1813. Bill au. the constr. of brs. across the Missouri, Mississippi, and Illinois Rs., and prescribing the character, location, and dimensions of the same, **88**, 2384. Draft of the bill au. constr. of brs. across the above-named Rs., **00**, 5117. PLANS.—Dimensions of spans and draw openings, as fixed by the board of 1888, for brs. over the Mississippi, Missouri, and Illinois Rs., **88**, 2372-2373. PROJECTS.—Decisions of BE., 1900, **00**, 5104. SURVEYS.—Maps. Made by Maj. Warren of surveys for brs. over the Mississippi R., **73**, 817; **78**, 1126.

NEABSCO CREEK, Va. (Dr.) **07**, 815.

NEABSCO, POWELLS, QUANTICO, and **AQUIA CREEKS,** Va. (S.) (Washington Southern Ry. Co.) PLANS.—Rebuilding approv. Dec. 24, 1903, **04**, 716.

NECHES R., Beaumont, Tex. (S.) (Texarkana & Fort Smith Ry. Co.) PLANS.—Approv. Sept. 12, 1896, **97**, 531.

NEHALEM R., S. Fork, Oreg. (S.) (Tillamook County br.) PLANS.—Approv. Aug. 10, 1909, **10**, 1024.

NEMADJI R., Superior, Wis. (S.) (Northern Pacific Ry. Co.) PLANS.—Rebuilding approv. July 16, 1903, **04**, 713.

NEPONSET R., Boston and Quincy, Mass. (A.) (New York, New Haven & Hartford R. R. Co.) PLANS.—Reconstr. approv. July 24, 1905, **06**, 808.

NEPONSET R., between Boston and Milton, Mass. (S.) (City br.) PLANS.—Rebuilding approv. Oct. 5, 1909, **10**, 1024.

NEPONSET R., Quincy and Neponset, Boston, Mass. (O.) (New York, New Haven & Hartford R. R. Co., lessee of Old Colony R. R. Co.) PLANS.—Alterations to be completed on or before Dec. 31, 1904, **05**, 729.

NEPONSET R., between Boston and Quincy, at Neponset Avenue and Hancock Street, Boston, Mass. (City br.) PLANS.—Rebuilding fender ps. approv. June 2, 1911, **11**, 1089.

NESHAMINY CREEK, near Croydon, Pa. (S.) (Philadelphia, Bristol & Trenton Street Ry. Co.) PLANS.—Approv. Oct. 17, 1902, **03**, 646.

NEUSE R., N. C. (S.) (Wilmington & Weldon R. R. Co.) PLANS.—Approv. Dec. 17, 1894, **95**, 477.

NEUSE R., near Canadys Landing, N. C. (S.) (Lenoir County br.) PLANS.—Approv. June 22, 1904, **04**, 719.

NEUSE R., Goldsboro, N. C. (Wilmington & Weldon R. R. Co.) PLANS.—Capt. Bixby recom. br. be permitted to remain in its condition, provided the owners should clear away the obstr. portion of the old p. beneath, **88**, 2545.

NEUSE R., Kinston, N. C. (Atlantic & North Carolina R. R. Co.) Capt. Bixby R. br. no obstr. to navigation, **88**, 2545. PLANS.—Approv. Dec. 23, 1905, **06**, 803.

NEUSE R., near Kinston, N. C., and **NEWPORT R.,** near Newport, N. C. (S.) (Howland Imp. Co.) PLANS.—Reconstr. approv. Jan. 23, 1905, **05**, 725.

NEUSE R., at or near Maple Cypress, N. C. (S.) (Craven County br.) PLANS.—Approv. Oct. 2, 1906, **07**, 822.

NEUSE R., Newbern, N. C. (S.) (Craven County br.) PLANS.—Modified plans approv. Mar. 22, 1898, **98**, 535.

NEUSE R., Newbern, N. C. (S.) (Pamlico, Oriental & Western R. R. Co.) PLANS.—Approv. July 29, 1903, **04**, 713.

NEWARK B., between Elizabethport and Bayonne, N. J. (S.) (Central R. R. Co. of New Jersey.) PLANS.—Reconstr. approv. June 12, 1902, **02**, 589.

NEWARK B., N. J., and tributaries. (Dr.) **02**, 581; **07**, 815; **10**, 1019.

NEWARK SLOUGH, near Potrero Pt., San Francisco B., Cal. (S.) (Southern Pacific Co.) PLANS.—Approv. Sept. 6, 1906, **07**, 821, 822.

NEW HAVEN, Conn. (See Coscob, etc.)

NEW HAVEN H., Conn. (Dr.) **02**, 581.

NEW MEADOWS R., between Brunswick and West Bath, Me. (S.) (Lewiston, Brunswick & Bath Street Ry. br.) PLANS.—Approv. May 23, 1898, **98**, 535.

NEW MEADOWS R., Bath, Me. (O. and A.) (City br.—Bull Rock Br.) PLANS.—Specified alterations to be completed on or before 30 days from date of service of notice, May 31, 1901, **01**, 669.

NEW MILL CREEK, Norfolk County, Va. (S.) (Elizabeth River R. R. Co.) PLANS.—Approv. July 20, 1906, **07**, 820.

NEWPORT B. (inner chan.), Orange County, Cal. (S.) (W. S. Collins.) PLANS.—Approv. June 12, 1911, **11**, 1090.

NEWPORT R., N. C. (Dr.) **08,** 865.

NEWPORT H., tidewaters between Sheeps Pt. and Gull Rocks, R. I. (S.) (Robert N. Carson.) PLANS.—Approv. June 7, 1904, **04,** 719.

NEWPORT R., Morehead City to Beaufort, N. C. (S.) (Atlantic & North Carolina Co.) PLANS.—Approv. Aug. 22, 1905, **06,** 801.

NEW R., near Fort Lauderdale, Fla. (S.) (Florida East Coast Ry. Co.) PLANS.—Reconstr. approv. Feb. 8, 1909. Modified plans approv. Mar. 19, 1909. **09,** 917.

NEWTON CREEK, Greenpoint Avenue, New York, N. Y. (S.) (City br.) PLANS.—Reconstr. plans approv. June 17, 1898, **98,** 536.

NEWTON CREEK, between Long Island City and Brooklyn, N. Y. (A.) (Brs. of Kings and Queens Counties.) PLANS.—Proceedings instituted against the br. at Manhattan Avenue (Vernon Avenue); alteration plans, together with plans for a temporary br., approv. May 7, 1895, **95,** 481. Revised plans approv. Nov. 21, 1896, **97,** 535. Alteration plans approv. June 3, 1898, **98,** 537.

NEWTON CREEK, Meeker Avenue, Brooklyn, N. Y. (O.) (Kings and Queens Counties br.) PLANS.—Specified alterations to drawbr. required on or before Oct. 1, 1892, **92,** 411.

NEWTON CREEK, between Vernon and Manhattan Avenues, New York, N. Y. (O.) (City br.) PLANS.—Specified alterations to be completed June 30, 1899, **98,** 538.

NEWTOWN CREEK, N. Y. (Dr.) **02,** 581; **04,** 710.

NEWTOWN CREEK, Vernon Avenue to Manhattan Avenue, New York City. (S.) (City br.) PLANS.—Constr. of temporary br., pending completion of permanent str., approv. June 15, 1901, **01,** 667.

NEZPIQUE BAYOU, near Jennings, Acadia, and Calcasieu Parishes, La. (S.) (Parish br.) PLANS.—Reconstr. approv. Jan. 13, 1906, **06,** 803.

NIAGARA R. (See Black Rock H.)

NIAGARA R., Buffalo, N. Y. (S. and Sp.) (Grand Trunk Ry. Co., international br.) ENGINEERS.—Chief of Engineers. **R., 70,** 218; **71, 49; 99,** 619. BE. convened at Buffalo, Oct. 3, 1870, submitted preliminary **R.,** and adjourned awaiting information from br. company and New York canal officers, **71,** 219. Reconvened at Washington, Jan. 28, 1871. **R.,** approv. location and plan, with certain modifications. **R., 71,** 219. Approv. by Sec. of War, **71,** 218. (Majs. Warren, Merrill, and Harwood.) LEGISLATION.—Company au. to constr. br. by acts June 30, 1870, and June 23, 1874, **71,** 49 219; **99,** 619. Legislation suggested by BE., **71,** 221. PLANS.—Described, **71,** 219. Reconstr. plans of the superstr. approv. Mar. 29, 1899, **99,** 619.

NIAGARA R., Grand Isld., near Buffalo, N. Y. (Sp.) (Niagara River Br. Co.) LEGISLATION.—Company au. to constr. br. by act June 29, 1898. PLANS.—Approv. June 2, 1899, **99,** 619.

NIAGARA R., Lewiston, N. Y. (Sp.) (Lewiston Connecting Br. Co.) LEGISLATION.—Company au. to constr. br. by act May 22, 1896. PLANS.—Approv. Aug. 11, 1898, **98,** 532.

NIANTIC R., East Lyme, Conn. (S.) (New York, New Haven & Hartford R. R. Co.) PLANS.—Approv. Oct. 30, 1906, **07,** 823.

NIOBRARA R., between the Santee and Ponca Reservations, Nebr. APPROPRIATIONS.—1908, $12,000, **08,** 2517. ENGINEERS.—Chief of Engineers. **08,** 904; **09,** 948; **10,** 1060. In charge: Majs. E. H. Schulz, **09,** 2517; **10,** 2743. OPERATIONS.—**1908–09.** Work commenced Jan. 11, 1909, and finished and accepted Apr. 28, 1909, **09,** 949, 2517. **1909–10.** Incidental expenses connected with minor work, **10,** 2743. PROJECTS.—Act Apr. 30, 1908, app. $12,000 for repairing br. over Niobrara R., between Santee and Ponca Reservations. Nebr., **08,** 904.

NISQUALLY R., Wash. (S.) (Br. of Pierce and Thurston Counties.) PLANS.—Approv. June 15, 1910, **10,** 1030.

NISQUALLY R., Pierce County (sec. 8, T. 18 N., R. 1 E., Willamette meridian), Wash. (S.) PLANS.—Approv. Oct. 27, 1910, **11,** 1084.

NOOKSAK R., Ferndale, Wash. (Sp., etc.) (Whatcom County br.) LEGISLATION.—County au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Washington, **92,** 408. PLANS.—Approv. Aug. 4, 1892, **92,** 408; modified plans approv. Feb. 25, 1893, **93,** 468.

NOOKSAK R., Lyden (Lynden), Wash. (Sp., etc.) (Whatcom County br.) LEGISLATION.—County au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Washington. PLANS.—Approv. Aug. 4, 1892, **92,** 408. Rebuilding approv. Apr. 4, 1906, **06,** 805.

NOOKSAK R. (Larrabee Slough), Marietta, Wash. (S.) (Whatcom County br.) PLANS.—Reconstr. approv. Mar. 11, 1909, **09,** 917.

NOOKSAK R., Orvis Ferry, Wash. (S.) (Whatcom County br.) PLANS.—Approv. Feb. 17, 1898, **98,** 534.

NOOKSAK R., Whatcom County, Wash. (S.) (Whatcom County br.) PLANS.—Approv. Sept. 6, 1904, **05,** 724.

NORTH EAST CREEK (Back R.), Md. (S.) (Chesaco Br. Co.) PLANS.—Approv. Feb. 23, 1911, **11,** 1087.

NORTHEAST R., Castle Hayne, N. C. (O.) (Atlantic Coast Line R. R. Co.) PLANS.—Notice dated Feb. 18, 1911, was addressed to the president of the company, **11,** 1091.

NORTHEAST R., near Castle Hayne, N. C. (S.) (Br. of New Hanover and Pender Counties, N. C.) PLANS.—Approv. May 17, 1912, **12,** 1307.

NORTHEAST (Cape Fear) **R.,** at Hilton (Wilmington), N. C. (O.) (Wilmington Ry. Br.

Co.) PLANS.—Alterations to be completed within 6 months from Sept. 9, 1910, **11**, 1091.

NORTH MENOMINEE CANAL, 16th Street, Milwaukee, Wis. (S.) (City br.) PLANS.—Approv. July 29, 1893, **93**, 470.

NORTH POINT CREEK and **JONES** (or Welshmans) **CREEK,** Baltimore County, Md. (S.) (Baltimore, Sparrows Point & Chesapeake Ry. Co.) PLANS.—For these brs. approv. Dec. 20, 1904. Plans in lieu thereof approv. Sept. 27, 1905. **06**, 802.

NORTH POINT THOROFARE, N. J. (S.) (Long Beach Turnpike Co.) PLANS.—Approv. Mar. 14, 1912, **12**, 1306.

NORTH R., Carteret County, N. C. (S.) (Carteret County br.) PLANS.—Approv. Apr. 21, 1909, **09**, 917.

NORTONS CREEK, Hempstead, Queens County, N. Y. (S.) (Hempstead City br.) PLANS.—Approv. Feb. 6, 1894. **B.** completed, **94**, 427.

NORWALK R. (or R.), South Norwalk, Conn. (S.) (New York New Haven & Hartford R. R. Co.) PLANS.—Approv. Apr. 4, 1895, **95**, 478.

NORWALK R., Conn. (Dr.) **02**, 581.

NORWALK R., Washington Street, Norwalk. Conn. (S.) (Town br.) PLANS.—Approv. Mar. 1, 1912, **12**, 1305.

NOTTOWAY R., Monroe, Va. (S.) (Southampton County br.) PLANS.—Rebuilding approv. Aug. 22, 1905, **06**, 801.

NOVATO CREEK, Marin County, Cal. (S.) (Bay Counties Ry. Co.) PLANS.—Approv. July 16, 1906, **07**, 820.

NOXUBEE R., Ala. (Sp.) (Alabama, Tennessee & Northern R. R. Co.) Au. act Aug. 5, 1909. PLANS.—Approv. Aug. 11, 1909, **10**, 1020.

NUECES R., Tex. (S.) (Brownsville & Mexico Ry. Co.) PLANS.—Approv. Feb. 27, 1904, **05**, 726.

O.

OAK CREEK, Md. (Dr.) **02,** 581.

OAKLAND H., Alice and Harrison Streets, Alameda, Cal. (O. and A.) (Southern Pacific Co. and Central Pacific R. R. Co.) PLANS.—Alteration: A draw in br. at Alice Street of not less than 150′ clear opening, to be operated by other than hand power and to be completed within 15 months from May 28, 1896, **96,** 428. In lieu of above orders, plans for a new br. at Harrison Street, to replace str. at Alice Street, approv. Apr. 30, 1897, **97,** 535.

OAKLAND H., Webster Street, Alameda, Cal. (O. and A.) (Alameda County br.) PLANS.—Alteration: A draw of not less than 150′ clear opening, to be operated by other than hand power, and to be completed within 15 months from May 29, 1896, **96,** 428. Alteration plans in accordance with above requirements submitted Apr. 15, 1898; approv. Aug. 11, 1898, **98,** 538.

OBION R., near Bandmill, Tenn. (S.) (Dyersburg-Northern R. R. Co.) PLANS.—Approv. May 7, 1906, **06,** 806.

OBION R., near Burnt Mills, Dyer County, Tenn. (S.) (Dyer County br.) PLANS.—Approv. Sept. 19, 1902, **03,** 646.

OBION R., near Lanes Ferry, Tenn. (S.) (Dyer County br.) PLANS.—Approv. June 17, 1901 **01,** 667.

OBION R., Mengelwood (Bandmill), Tenn. (S.) (Mengel Box Co.) PLANS.—Approv. Aug. 22, 1907, **08,** 869.

OBION R., Pettys Ferry, Tenn. (S.) (Dyer County br.) PLANS.—Approv. Aug. 7, 1903, **04,** 713.

OCEANPORT, N. J. (See Shrewsbury R.)

OCHLOCKONEE R., McIntyre, Fla. (O.) (Carrabelle, Tallahassee & Georgia R. R. Co.) PLANS.—Removal of the row of piles from center of one of the open spans, to afford a clear opening of 32′, to be completed on or before June 1, 1894; work completed, **94,** 431.

OCKLOCKONEE R., Fla. (O.) (Brs. of Leon and Gadsden Counties—Fairbanks Ferry br. and Stewart br.) PLANS.—Alterations to be completed within 120 days from Jan. 28, 1908, **08,** 874.

OCKLOCKONEE R., Ga. (O.) (Grady County br.—Hadley Ferry br.) PLANS.—Alterations to be completed within 120 days from Jan. 30, 1908, **08,** 874.

OCKLOCKONEE R., Leon County, Fla. (S.) (Leon County br.) PLANS.—Approv. Apr. 8, 1903, **03,** 649. Approv. Aug. 3, 1904, **05,** 723.

OCKLOCKONEE R., Leon and Gadsden Counties, Fla. (O.) (Georgia, Florida & Alabama R. R. Co.) PLANS.—Alterations to be completed within 7 months from Jan. 27, 1908, **08,** 874.

OCKLOCKONEE and SOPCHOPPY RS., near Sopchoppy, Fla. (O.) (Carrabelle, Tallahassee & Georgia R. R. Co.) PLANS.—Alterations to be completed within 2 months from Dec. 23, 1902, **03,** 652.

OCMULGEE R., above Hawkinsville and below Macon, Ga. (O.) (East Tennessee, Virginia & Georgia R. R.) LEGISLATION.—Notices served as to alterations required, **90,** 343. PLANS.—Capt. Hoxie recom. insertion of 60′ draws in each br., **88,** 2552.

OCMULGEE R., near Lumber City, Ga. (O.) (East Tennessee. Virginia & Georgia Ry. Co.) PLANS.—Alterations required by Aug. 1, 1889, **89,** 377.

OCMULGEE R., Macon, Ga. (Sp., etc.) (S.) (Macon, Dublin & Savannah R. R. Co.) LEGISLATION.—Company au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Georgia. PLANS.—Approv. July 5, 1892, **92,** 406. Approv. Mar. 9, 1911, **11,** 1087.

OCOEE R., Tenn. (See Hiwassee R.)

OCONEE R., above Dublin, Ga. (A.) (Central R. R.) PLANS.—Capt. Hoxie recom. insertion of a draw with 60′ clear span, **88,** 2552.

OCONEE R., at or near Dublin, Ga. (Sp.) (Lawrence County br.) LEGISLATION.—County au. to constr. br. by act June 18, 1888. PLANS.—Approv. Aug. 17, 1888, **89,** 369.

OCONEE R., Dublin, Ga. (Sp.) (Macon, Dublin & Savannah R. R. Co.) LEGISLATION.—Company au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Georgia. PLANS.—Approv. Jan. 27, 1891, **91,** 430.

OCONEE R., Dublin, Ga. (S.) (Macon, Dublin & Savannah R. R. Co.) PLANS.—In substitution for those heretofore approv. were approv. Aug. 6, 1901, **02,** 584.

OCONEE R., Ga. (O.) LEGISLATION.—Notice served as to alterations required, **90,** 344.

OCONEE R., near Dublin, Ga. (Sp.) (Wrightsville & Tennille (Tennville) R. R. Co.) LEGISLATION.—Company au. to constr. br. by act May 21, 1890. PLANS.—Approv. Nov. 17, 1890, **91,** 429.

OCONEE R., Ga. (Dr.) **06,** 797.

OCONTO R., Oconto, Wis. (S.) (Chicago & North Western Ry. Co.) PLANS.—Br. to replace existing str. approv. Nov. 21, 1903, **04,** 715.

OGEECHEE R., Ga. (S.) (Chatham County br.) PLANS.—Rebuilding approv. Sept. 5, 1907, **08**, 869.

OGEECHEE, ALTAMAHA, and **SATILLA RS.**, Ga. (S.) (Florida Central & Peninsula R. R. Co., on the line of its Savannah extension.) PLANS.—Approv. Feb. 21, 1893, **93**, 468.

OHIO R. ENGINEERS.—Chief of Engineers. **R., 00**, 40. BE. On House bill No. 1065, 56th Congress, 1st session, "To au. constr. of brs. across the Ohio, Monongahela, Mississippi, Kanawha, Tennessee, Cumberland, and Illinois Rs., and to prescribe the dimensions of the same." **R., 00**, 5103. (Lt. Col. M. B. Adams Maj. C. F. Powell, Maj. J. H. Willard, Maj. W. H. Bixby, Maj. D. C. Kingman, Capt. H. F. Hodges, and Capt. E. Burr.) Engineer in charge: Lt. Col. G. K. Warren, 1879. **R., 79**, 1463. PROJECTS.—Principal features and cost of the following brs.: Steubenville R. R., Wheeling (highway), Bridgeport (highway), Bellaire R. R., Parkersburg R. R., Newport & Cincinnati R. R. (as commenced), Newport & Cincinnati R. R. (as altered), Covington and Cincinnati (highway), Louisville R. R., Paducah R. R. **R., 79**, 1463.

OHIO R. (Dr.) **02**, 581.

OHIO R., brs. over, impeding safe and convenient navigation. The R. and H. act approv. June 13, 1902, contains the following item: "The Sec. of War is au. and directed to prepare a list of the brs. upon the Ohio R. which are an impediment to safe and convenient navigation, and the nature and extent of the modifications required in each of them, and **R.** the same to Congress, together with information as to whether necessary changes in said brs., or any of them, can be secured under existing law, and if not, what legislation is necessary in order to secure proper changes or modifications in said brs., respectively, and an est. of the cost thereof on each br.: Provided, That the Atty. Gen. is au. and directed to furnish, upon the request of the Sec. of War, an opinion upon the question whether the owners of these brs., or any of them, can be required, under existing laws, to make the necessary changes at their own expense, and, if further legislation is required, whether by such legislation the owners of such brs., or any or either of them. can be required to make such changes and modifications at their own expense, or whether such changes or modifications, or any or either of them, must be borne by the U. S., which opinion shall accompany the **R.** of the Sec. of War to Congress." The duty of preparing the required information was duly assigned to the local officer having charge of the general imp. of the R., and it is expected that **R.** on the subject will be received in time for consideration by the Atty. Gen. and transmission to Congress at its next session. **03**, 37. **R.** by Col. G. Lydecker, together with copy of an opinion dated July 15, 1904, furnished by Atty. Gen. in pursuance of the law. List of brs. which are considered impediments to safe and convenient navigation. **04**, 2433.

OHIO R., between Allegheny City and Borough of McKees Rocks, Pa. (Sp.) (Western Br. Co.) Au. act Apr. 30, 1902. PLANS.—Approv. Feb. 5, 1903, **03**, 644.

OHIO R., Beaver, Pa. (Sp.) (Pittsburgh & Lake Erie R. R. Co.) ENGINEERS.—Chief of Engineers. **R., 78**, 110, 891, 895; **80**, 199, 1849; **84**, 269, 1787; **87**, 338, 2659. BE. convened at Pittsburgh, Pa., Aug., 1877. Recom., **78**, 894. **R., 78**, 892. Approv. by Chief of Engineers and Sec. of War, **78**, 895, 896. (Col. Simpson, Majs. Weitzel and Merrill.) Convened in 1883 to ex. questions at issue with a view of avoiding legislation, **84**, 269. Br. an obstr. to navigation; failure to effect satisfactory arrangements with the company for the correction of the evil, **84**, 1786; **87**, 2655. (Lt. Cols. Craighill and Weitzel and Maj. Mackenzie.) LEGISLATION.—Executive requirements, **80**, 199, 1849; **87**, 2655. Company au. to constr. br., under acts Dec. 17, 1872, and Feb. 14, 1883, **89**, 371. PLANS.—Proposed by R. R. company; modification of, by BE., **78**, 894. R. R. company required to build in connection with the br. a dike for the protection of navigation, **80**, 199, 1849. Maj. Merrill **R.** that such dike not built, **80**, 1849. Dept. of Justice decided that the U. S. powerless to compel R. R. company to build dike, **80**, 1852. Subsequent changes of opinion, **84**, 1787, 1788; **87**, 2655. Submitted Nov. 26, 1888, to rebuild a part of the superstr. approv. Mar. 25, 1889, on specified conditions, which were accepted by the company Feb. 28, 1889, **89**, 371. Rebuilding considered by a BE. and approv. Oct. 29, 1907. **08**, 866. SURVEY.—Map. Location of br., **78**, 892.

OHIO R., Bellaire, Ohio. (Sp.) (R. R.) COMMERCE.—Serious accident by collision with ps., **71**, 403, 411. Losses by collision with ps., $60,500, **71**, 411, 429. ENGINEERS.—BE. recom., 1870, no change, and commended the excellent manner of constr., **71**, 411. **R., 71**, 408, 425. (Majs. Warren, Weitzel, and Merrill.) LEGISLATION.—Br. au. by act July 14, 1862, **71**, 408. Act July 11, 1870, constituting BE., **70**, 67; **71**, 61, 426. PLANS.—Description of br., **71**, 408.

OHIO R., between Bellaire, Ohio, and Benwood, W. Va. (Sp.) (Bellaire, Benwood & Wheeling Br. Co.) LEGISLATION.—Au. by act Dec. 17, 1872; and plans referred to BE., as required by act Feb. 14, 1883, sec. 4, **98**, 531. PLANS.—Submitted Feb. 16, 1897. BE. recom., Apr. 23, 1897, chan. span 800′ long and 90′ above l. w.; modified plans in accordance submitted Apr. 22, 1898; approv. May 26, 1898, **98**, 531. Plans conforming to requirements of BE. approv. June 14, 1901, **01**, 660, 661. Br. not completed within the time limit. Plans reapprov. Apr. 21, 1904. **04**, 712. Plans reapprov. Nov. 29, 1905, and plans in lieu thereof approv. Apr. 20, 1906, **06**, 800. Plans reapprov. Apr. 24, 1907, **07**, 819.

OHIO R., Cairo, Ill. (Sp.) COMMERCE.—Dimensions of Ohio R. steamers, **86**, 2121. Protests of C. interests against the br., **86**, 2130. ENGINEERS.—Chief of Engineers. **R., 86**,

369, 2127. BE. **R.** adversely to a draw and recom. clear headway of 53′ above h. w., **86,** 2127. (Lt. Cols. Abbot and Poe, and Majs. Mackenzie and Allen.) LEGISLATION.—Au. by acts Dec. 17, 1872, and Feb. 14, 1883, **86,** 370. PLANS.—Proposed by br. company considered inadmissible by BE., **86,** 2127. Recom. of BE., **86,** 2127. Concurred in by Chief of Engineers.

OHIO R., between Chester, W. Va., and E. Liverpool, Ohio. (Sp.) (East Liverpool Br. Co.) **94,** 425; **96,** 422. LEGISLATION.—Au. by acts Dec. 17, 1872, and Feb. 14, 1883, **94,** 425. PLANS.—Submitted May 11, 1894, for 500′ span, referred to a BE., which recom. 650′ in the clear. Modified plans approv. July 2, 1894. **94,** 425. Company reorganized; modified plans approv. Sept. 3, 1895, **96,** 422.

OHIO R., Cincinnati, Ohio. (Sp.) COMMERCE.—Method of towing, **76,** ii, 303. Coal interests, **76,** ii, 303, 304. Chamber of C. committee, **R.** of, **76,** ii, 304. ENGINEERS.—Chief of Engineers. **Rs., 76,** 92, ii, 298, 306, 307. Approv. modified plan as proposed by board, **76,** ii, 307. Approv. by Sec. of War, **76,** ii, 308. BE. convened at Cincinnati, Ohio, Aug., 1874. Disapprov. of location unless width of chan. space be increased to 500′, **76,** ii, 299, 305. Addl. cost of span, $75,000, **76,** ii, 306 **R., 76,** ii, 300. (Col. Simpson, Majs. Merrill and Suter.) LEGISLATION.—Br. au. by act Dec. 17, 1872, **76,** ii, 299. PLANS.—Description of proposed br., **76,** ii, 302.

OHIO R., Cincinnati, Ohio. (Sp.) (Newport & Cincinnati Br. Co.) LEGISLATION.—Orig. constr. au. by act Mar. 3, 1871. General laws of Dec. 17, 1872, and Feb. 14, 1883, required larger chan. clearance. **93,** 464. PLANS.—Feb. 15, 1893, plans submitted for reconstr. by widening but not altering the dimensions of the chan. span. Lt. Col. Stickney recom. the company be required to rebuild according to the existing law. The company's plans approv. Mar. 6, 1893. **93,** 464. Apr. 30, 1895, the Pennsylvania R. R. Co., controlling the br., submitted new plans for a greater height and length of chan. span and to be in lieu of the old plans; approv. May 21, 1895, **95,** 475 .

OHIO R., between Cincinnati, Ohio, and Covington, Ky. (See below.) (Sp.) BE. **Rs.** of board of 1886, **87,** 2616, 2621. LEGISLATION.—Br. au. by act May 20, 1886, **87,** 337. PLANS.—BE. of 1886 disapprov. location of br., **87,** 337. Approv. of changed location and plan, **87,** 337, 2631.

OHIO R., between Cincinnati, Ohio, and Covington, Ky. (Sp., etc.) (Cincinnati & Covington Rapid Transit Br. Co.) LEGISLATION.—Company au. to constr. br. by acts Dec. 17, 1872, and Feb. 14, 1883. PLANS.—Referred to BE.; modified plans based upon **R.** of board approv. July 27, 1892, **92,** 407.

OHIO R., between Cincinnati, Ohio, and Newport, Ky. (Central R. R. & Br. Co.) **88,** 309, 2482. BE. convened at Cincinnati, Mar. 17, 1888, by S. O. No. 11, to ex. and **R.** upon plans and location of proposed br. across the Ohio R. between Cincinnati, Ohio, and Newport, Ky. **R., 88,** 2483. (Lt. Col. Poe and Majs. Stickney and Mackenzie.) LEGISLATION.—Au. by acts Dec. 17, 1872, and Feb. 14, 1883, **88,** 2480. PLANS.—Description of proposed br., **88,** 2482. The board of 1888 recom. approv. of plans and location of proposed br. as set forth by the Central R. R. & Br. Co., **88,** 2484.

OHIO R., below Ceredo, W. Va. (Sp.) (West Virginia & Ironton R. R. Co.) LEGISLATION.—Au. by acts Dec. 17, 1872, and Feb. 14, 1883. PLANS.—Plan and location submitted; approv. by Sec. of War, Dec. 24, 1889, **90,** 337.

OHIO R., near the mouth of Corks Run. (Sp.) (Ohio Connecting R. R. Co.) **88,** 309, 2498, 2504, 2506. BE. convened at Washington, June 25, 1887 by S. O. No. 60, to consider and **R.** upon plans for the proposed br. across the Ohio R., about 1 m. below the junction of the Allegheny and Monongahela Rs., submitted by the Ohio Connecting R. R. Co. **R., 88,** 2499. (Lt. Cols. Merrill and Barlow, Maj. Stickney, and Lt. Spencer.) Second **R.** of board, **88,** 2505. (Lt. Cols. Merrill and Barlow, and Maj. Stickney.) LEGISLATION.—Br. au. by acts Dec. 17, 1872, and Feb. 14, 1883, **88,** 2498. PLANS.—Board of 1887 recom. site selected by the br. company be accepted on condition that the axis of the br. be changed to lie at right angles to the line of the current, and that the chan. space be increased to 800′, but that otherwise the site be rejected, **88,** 2502. Revised plans approv. by the board on Oct. 4, 1887, **88,** 2506.

OHIO R., Covington, Ky. (See above.) (S. and Sp.) (Suspension.) BE. recom., 1870, no changes, **71,** 416, 419. **R., 71,** 414, 454. (Majs. Warren, Weitzel, and Merrill.) LEGISLATION.—First charter granted by Ky., Feb., 1846; confirmed by Ohio, Mar., 1849; amended 1856, **71,** 415. Br. au. by Congress, Feb. 17, 1865, **71,** 415, 428; **78,** 1089. PLANS.—Description of plans, **71,** 414. Cost of br., $1,480,000, **71,** 419, 425.

OHIO R., East Cairo, Ky. (Sp.) (Chicago, St. Louis & New Orleans R. R. Co.) **88,** 308, 2437. LEGISLATION.—Au. by acts Dec. 17, 1872, and Feb. 14, 1883, **88,** 2437. PLANS.—Description of proposed br., **88,** 2436.

OHIO R., Evansville, Ind. Chief of Engineers. **Rs., 72,** 440; **78,** 110; **79,** 149. Recom. modification of act au. constr. of brs. across the Ohio R., **72,** 440. BE. convened at Evansville, Ind., Nov., 1877; unable to reach any conclusions for want of h. w. surv., **78,** 110; **79,** 149. (Majs. Warren, Weitzel, and Merrill.)

OHIO R., Henderson, Ky. (Sp.) **82,** 263, 1989; **86,** 370, 2138 2140. COMMERCE.—Requirements of the Ohio R., **82,** 1990. BE. **R., 82,** 1992. (Lt. Col. Comstock, Majs. Weitzel and Merrill.) LEGISLATION.—Br. au. by act Dec. 17, 1872, **82,** 1990. PLANS.—Description of spans proposed, **82,** 1891. Changes in plan approv. by BE. made without its approv., **86**, 2136, 2139. Modifications subsequently approv., **86**, 2140. BE. recom. plan submitted by R. R. company for approv., **82**, 1992.

OHIO R., at Huntington, W. Va. (Sp.) (Huntington Northern R. R. Co.) Au. act Dec. 17, 1872; Feb. 14, 1883; and July 13, 1892. PLANS.—As amended, approv. June 15, 1910, **10**, 1023.

OHIO R., Ironton, Ohio, to Ashland, Ky. (Sp.) (Ashland & Ironton Br. Co.) Au. acts Dec. 17, 1872, and Feb. 14, 1883. PLANS.—Conforming to requirements of BE. approv. Apr. 22, 1901, **01**, 660. Constr. under the plans approv. Apr. 22, 1901, not having been commenced within the limit of time prescribed, approv. became null and void. Plans reapprov. Feb. 16, 1903, **03**, 644. Not having been completed within the time limit, it became necessary to again approv. the plans and this was done Jan. 29, 1904, **04**, 711. Statutory time for completion having expired, plans were reapprov. Feb. 15, 1905, **05**, 721. Plans were reapprov. Feb. 14, 1908, **08**, 867, and again on Feb. 13, 1911, **11**, 1080.

OHIO R., Kenova, W. Va. (Sp.) (Norfolk & Western Ry. Co.) Au. acts Dec. 17, 1872, and Feb. 14, 1883. PLANS.—Reconstr. of superstr. of existing br. approv. July 18, 1911, **12**, 1295.

OHIO R., Liverpool (East), Ohio. (Sp.) (Newell Br. Co.) Au. acts Dec. 17, 1872, and Feb. 14, 1883. PLANS.—Considered by a BE. and approv. July 9, 1903, **04**, 711.

OHIO R., Louisville, Ky. (Sp.) COMMERCE.—Losses by collision with ps. of brs., $26,704, **71**, 421, 429. ENGINEERS.—Chief of Engineers. **R.**, **82**, 263, 1988. BE. on Ohio R. brs. considered this a first-class str. in all respects, **71**, 421. Recom. no changes of location or plan, **71**, 421. **R.**, **71**, 419, 454. (Majs. Warren, Weitzel, and Merrill.) **R.**, **82**, 1988. (Lt. Col. Comstock and Majs. Weitzel and Merrill.) LEGISLATION.—Br. au. by acts July 14, 1862, and Feb. 17, 1865, **71**, 419, 428; **78**, 1089. Act July 11, 1870, constituting BE., **70**, 67; **71**, 61, 426. Br. au. by act Dec. 17, 1872, **82**, 1986. Requirements of Ohio, **82**, 1987. PLANS.—Description of br., **71**, 419. Cost of br., $1,615,120, **71**, 421, 425. Modification of previous plans, **82**, 1986. Approv. of plans by BE., **82**, 1988. BE. recom. plans adopted by R. R. company be approv., **82**, 1988.

OHIO R., between Louisville, Ky., and Jeffersonville, Ind. (Sp.) (Louisville & Jefferson Br. Co.) ENGINEERS.—Chief of Engineers. **Rs.**, **89**, 370; **90**, 335. BE. constituted by S. O. No. 34, Apr. 19, 1889. **R.**, **90**, 3465. (Col. C. B. Comstock, Lt. Col. C. R. Suter, and Maj. C. J. Allen.) LEGISLATION.—Company au. to constr. br. under act Dec. 17, 1872; supple. act Feb. 14, 1883, **89**, 370. PLANS.—BE. recom. 650′ span, Indiana side, and 400′ span, Kentucky side; approv. Feb. 28, 1889, **89**, 370. Plans considered by second BE., Sept. 14, 1889, **90**, 3465. Modified plans approv. Oct. 19, 1889; new modification approv. Nov. 15, 1889. Substitution of l.-w. elevation of 1887 for that of 1889, approv. Jan. 29, 1890. **90**, 336.

OHIO R., between Louisville, Ky., and New Albany, Ind. (Sp.) (Kentucky & Indiana Br. & R. R. Co.) Au. acts Dec. 7, 1872; Feb. 14, 1883; and June 7, 1910. PLANS.—Reconstr. approv. June 7, 1910, **10**, 1022. Modified plans approv. July 30, 1910, **11**, 1079.

OHIO R., Louisville and Portland Canal. (Sp.) (Louisville & Portland Br. Co.) PLANS.—Reconstr. plans approv. Mar. 2, 1898, **98**, 531.

OHIO R., between Marietta, Ohio, and Williamstown, W. Va. (Sp.) (Marietta & Williamstown Br. Co.) LEGISLATION.—Company au. to constr. br. by act Dec. 17, 1872; amending act Feb. 14, 1883. PLANS.—Submitted Nov. 2, 1897; modified plans conforming to the requirements of the BE. submitted June 26, 1898; approv. Feb. 4, 1898, **98**, 531.

OHIO R., Mingo Junction, Ohio. (Sp.) (Cross Creek R. R. Co.) Au. acts Dec. 17, 1872, and Feb. 14, 1883. PLANS.—Considered by BE. and approv. Feb. 7, 1902, **02**, 582.

OHIO, MONONGAHELA, ALLEGHENY, MUSKINGUM, BIG SANDY, GUYANDOT, LITTLE KANAWHA, and BUCKHANNON RS. **88**, 2672. PLANS.—List of brs., with location, dimensions, and chan. span in the clear, on the Ohio, **88**, 2673; the Monongahela, **88**, 2674; the Allegheny, **88**, 2675.

OHIO R., Neville Isld., Pa., back chan. at the lower end of. (S.) (Pittsburgh & Lake Erie R. R. Co.) PLANS.—Approv. June 12, 1900, **00**, 701. New instrument executed July 24, 1900, in lieu of former dated June 12, 1900, **01**, 661.

OHIO R., Neville Isld., Pa., back chan. from Fleming Park to head of. (S.) (Pittsburgh & Lake Erie R. R. Co.) PLANS.—Approv. May 16, 1900, **00**, 701.

OHIO R., Newport, Ky. (Sp.) COMMERCE.—Losses by collision with ps. of br., **71**, 414, 420. Br. a serious obstr. to navigation, **71**, 431, 447. C. greatly increasing, **71**, 434, 448. ENGINEERS.—Chief of Engineers. **R.**, **71**, 61. BE. constituted by act July 11, 1870, **70**, 67; **71**, 61, 426. Discussion of the various acts relating to the Newport and Cincinnati br., **71**, 431, 432, 435. Proposed modifications, **71**, 452. Est. cost, $288,605, **71**, 452, 453. Modified plan of br. approv. by Sec. of War, **71**, 61. (Majs. Warren, Weitzel, and Merrill.) LEGISLATION.—Br. au. by acts July 14, 1862; Mar. 3, 1869; and Mar. 3, 1871, **71**, 61, 414, 427, 431, 435, 455; **78**, 1086. Act July 11, 1870, constituting BE., **70**, 67; **71**, 61, 426. Acts relating to br. referred to, **78**, 1090. PLANS.—Of BE. for increasing height of br. 28½′ and removal of draw span, **71**, 452. Description of present br., **71**, 440.

OHIO R., Paducah, Ky. (Sp.) (Proposed.) ENGINEERS.—BE. on Ohio R. brs. recom. joint resolution of Apr. 7, 1869, be repealed, and that a general act be passed to regulate the constr. of all future brs. over the Ohio R., **71**, 424. Copy of proposed act, **71**, 455. If built under act proposed br. would not be injurious to navigation, **71**, 424. **R.**, **71**, 424, 454. (Majs. Warren, Weitzel, and Merrill.) LEGISLATION.—Br. au. by act Apr. 7, 1869, **71,** 424, 428. Various acts relating to br. referred to, **78,** 1090, 1092.

OHIO R., at Paducah, Ky., and Metropolis, Ill. (Sp.) (Paducah & Illinois R. R. Co.) Au. acts Dec. 17, 1872, and Feb. 14, 1883. PLANS.—Approv. Sept. 17, 1910, **11,** 1079.

OHIO R., Parkersburg, W. Va. (Sp.) COMMERCE.—Losses by collision with ps. of br., $45,900, **71,** 414, 429. $30,000 raised by subscription, **71,** 412, 430. List of subscribers, **71,** 430. Petition to Congress to be reimbursed to the amount expended, **72,** 442. ENGINEERS.—Chief of Engineers. Recom. that the payment of increased cost caused by change of plan be provided for by the U. S. in the same manner as for the Newport and Cincinnati br., **72,** 441, 442. BE. on Ohio R. brs. recom. no change in this br., **71,** 414. **R.,** **71,** 411, 454. (Majs. Warren, Weitzel, and Merrill.) LEGISLATION.—Br. au. by act July 14, 1862, **71,** 411. Act July 11, 1871, constituting BE., **71,** 61, 426. PLANS.—Description of br., **71,** 411. Cost of br., $1,223,550, **71,** 414.

OHIO R., Parkersburg, W. Va. (S.) (Baltimore & Ohio R. R. Co.) PLANS.—Reconstr. of spans 35′. 36′, 37′, and 40′, approv. Jan. 15, 1901, **01,** 664.

OHIO R., Parkersburg, W. Va. (Sp.) (Parkersburg & Ohio Br. Co.) Au. acts Dec. 17, 1872, and Feb. 14, 1883. PLANS.—Considered by a BE., and approv. Jan. 9, 1907, **07,** 818.

OHIO R., Parkersburg, W. Va., and Belpre, Ohio (O.) (Baltimore & Ohio R. R. Co.—Parkersburg Branch R. R. Co.) PLANS.—Alterations to be completed on or before Dec. 1, 1908, **07,** 828.

OHIO R., between Parkersburg, W. Va., and Belpre, Ohio. (Sp.) (Parkersburg Br. Co.) Au. acts Dec. 17, 1872, and Feb. 14, 1883. PLANS.—As amended, approv. Jan. 13, 1910 **10,** 1020.

OHIO R., Pt. Pleasant, W. Va. ENGINEERS.—Chief of Engineers. **R.,** **82,** 263, 1998. BE. recom. approv. of plans provided chan. span be changed to position suggested by coal exchange, and that the lowest part of br. be at least 40′ above h. w., **82,** 2000. (Lt. Col. Comstock, Majs. Weitzel and Merrill.) PLANS.—Coal exchange at Pittsburgh recom. change of location in ps. proposed by the br. company, **82,** 2000. Modification accepted by company, **82,** 2000.

OHIO R., Pt. Pleasant, W. Va. (Sp.) (Kanawha & Michigan Ry. Co.) PLANS.—Reconstr. of superstr. of chan. span approv. Feb. 23, 1906, **06,** 799. Reconstr. of the side spans approv. Mar. 10, 1908, **08,** 867.

OHIO R., Rochester, Pa. (Sp.) (Ohio River Br. Co.) PLANS.—Act Feb. 14, 1883, sec. 4, the plans and map were referred to a BE., who recom. they be changed to provide chan. span 90′ above l. w. and 800′ long; modified plans in accordance approv. Nov. 9, 1895, **96,** 422.

OHIO R., Sewickley, Pa. (Sp.) (Coraopolis & Sewickley Br. Co.) LEGISLATION.—Company au. to constr. br. under act Dec. 17, 1872; amending act Feb. 14, 1883. PLANS.—Modified plans conforming to the requirements of the BE. approv. July 11, 1899, **99,** 620.

OHIO R., Sewickley, Pa. (Sp.) (Allegheny County br.) Au. acts Dec. 17, 1872, and Feb. 14, 1883. PLANS.—Considered by a BE., and approv. Feb. 6, 1908, **08,** 867.

OHIO R., Steubenville, Ohio. (Sp.) (Pittsburgh, Cincinnati, Chicago & St. Louis Ry. Co., successors of the Western Transportation Co.) COMMERCE.—Br. a serious obstr. to navigation, **71,** 402, 403. Losses by collision with the ps., **71,** 408, 429. Bad location of the br., **68,** 50, 316. Chan. contracted by riprap, **68,** 381. ENGINEERS.—Chief of Engineers. **Rs.,** **68,** 50; **89,** 369. BE. on Ohio R. brs. considered the Steubenville br. the most obstr. on the R., **71,** 403. Recom. that the chan. span be widened to 424′, at an est. cost of $200,414, **71,** 403, 404. Method of making the changes, **71,** 404. Total cost of present br., $1,000,000, **71,** 425. (Majs. Warren, Weitzel, and Merrill.) Engineer in charge, Maj. G. K. Warren. **Rs.,** **68,** 316, 380. LEGISLATION.—Western Transportation Co. au. to constr. br. by act July 14, 1862, **71,** 426; **89,** 369. Act July 11, 1870, constituting a BE., **70,** 67; **71,** 61, 426; **78,** 1088. PLANS.—Of Maj. Warren, increasing chan. span to 500′ width, **68,** 50, 316. Draft of laws required, **68,** 50, 316. Reconstr. chan. span for double track during July and Aug., 1889; approv. Dec. 22, 1888, **89,** 369.

OHIO R., Steubenville, Ohio. (O.) (Pittsburgh, Cincinnati, Chicago & St. Louis Ry. Co.) PLANS.—Alterations to be completed within 2 years from Jan. 29, 1908, **08,** 874.

OHIO R., between Steubenville, Ohio, and Cross Creek Township, W. Va. (Sp.) (Steubenville Br. Co.) Au. acts Dec. 17, 1872, and Feb. 14, 1883. PLANS.—Considered by a BE., and approv. June 29, 1903, **03,** 644, 645.

OHIO R., Wheeling, W. Va. (Sp.) (Wheeling & Harrisburg Ry. Co.) ENGINEERS.—Chief of Engineers. **Rs.,** **82,** 263, 1994; **84,** 269, 1773. BE. recom. modifications in plans submitted by the br. company, **82,** 1997. Modifications made and approv. by board, **84,** 1776. (Lt. Col. Comstock, Majs. Weitzel and Merrill.) LEGISLATION.—Br. au. by act Dec. 17, 1872, **82,** 1992. Supple. act Feb. 14, 1883, **84,** 1772. PLANS.—Description of span opening proposed by R. R. company, **82,** 1996. Modifications and recom. of the BE., **82,** 1997. Accepted by the br. company, **82,** 1998. Plans as modified approv. by BE., **84,** 1776.

OHIO R., Wheeling, W. Va. (Sp.) (Wheeling Br. Co.) **90,** 336. LEGISLATION.—Au. by acts Dec. 17, 1872, and Feb. 14, 1883, **90,** 337. PLANS.—Plan and location submitted, and approv. by Sec. of War, Oct. 26, 1889, **90,** 337.

OHIO R., Wheeling, W. Va., to Bridgeport, Ohio. (Sp.) ENGINEERS.—Chief of Engineers. **Rs.,** **70,** 67; **71,** 61. BE. on Ohio R. brs. did not recom. any changes in the Wheeling suspension br., **71**, 407. R., **71**, 405, 408. (Majs. Warren, Weitzel, and Merrill.) LEGISLATION.—Br. au. by act Aug. 3, 1852, **71**, 427. Act July 11, 1870, constituting BE., **70**, 67; **71**, 61, 426. Various acts relating to br., referred to, **78**, 1088, 1092. PLANS.—History of the Wheeling Br., **78**, 1029. Description of br., **71**, 405, 406. Orig. cost, $161,594, **71**, 407, 425. Destroyed by a hurricane in 1854; rebuilt at a cost of $37,000, **71**, 405, 407. Again rebuilt in 1860, at a cost of $55,000, **71**, 405, 407.

OHIO R., Wheeling, W. Va., to Martins Ferry Ohio. (Sp.) (Wheeling & Harrisburg Ry. Co.) LEGISLATION.—Company au. to constr. br. by act Dec. 17, 1872; supple. act Feb. 14, 1883. PLANS.—Orig. location approv. Dec. 10, 1883; amended location submitted Apr. 22, 1889; approv. May 18, 1889, **89**, 371.

OHIO R. (Back R.), between Wheeling Isld., W. Va., and Ohio shore. (Sp.) (Back River Br. Co.) Au. act June 25, 1906. PLANS.—Approv. July 14, 1906, **07**, 816.

OHIO R., Williamstown, W. Va., to Marietta, Ohio. (Sp.) (Ohio River Br. & Ferry Co.) Au. acts Dec. 17, 1872, and Feb. 14, 1883. PLANS.—Conforming to requirements of BE. approv. Dec. 13, 1900, **01**, 660.

OHIO R., Williamstown, W. Va., to Marietta, Ohio. (Sp.) (Williamstown & Marietta Br. & Transportation Co.) Au. acts Dec. 17, 1872, and Feb. 14, 1883. PLANS.—Considered by BE., and approv. June 25, 1901, **01**, 661.

OKANOGAN R., 12 m. n. of Brewster, Wash. (S.) (Great Northern Ry. Co.) PLANS.—Approv. Feb. 15, 1910, **10**, 1027.

OKANOGAN R., Okanogan, Wash. (Sp.) (Okanogan County br.) Au. act May 20, 1908. PLANS.—Approv. Jan. 8, 1909, **09**, 913.

OKANOGAN R., at Omak and Tonasket, Wash. (S.) (Brs. of Okanogan County.) PLANS.—Approv. Oct. 29, 1910, **11**, 1084.

OKANOGAN R., near Riverside, Wash. (S.) (Okanogan County br.) PLANS.—Approv. July 30, 1904, **05**, 723.

OKAW (Kaskaskia) **R.**, near Baldwin, Ill. (S.) (Mobile & Ohio R. R. Co.) PLANS.—Rebuilding approv. May 17, 1906, and new plans in lieu thereof approv. Aug. 8, 1906. **07**, 821.

OLD R., Cal. (S.) (San Francisco & San Joaquin Valley Ry. Co.) PLANS.—Approv. Oct. 28, 1898, **99**, 621.

OLD R., at Torras, La. (O.) (Texas & Pacific Ry. Co.) PLANS.—Alterations to be completed within 10 months from Mar. 29, 1910, **10**, 1031, 1032.

OLD TURTLE CREEK and GRASSY SOUND CHAN., township of Middle Cape May County, N. J. (S.) (Wildwood & Delaware Bay Short Line R. R. Co.) PLANS.—Approv. June 11, 1912, **12**, 1308.

OLDMANS CREEK, Pedricktown, N. J. (S.) (Br. of Salem and Gloucester Counties.) PLANS.—Rebuilding approv. Feb. 3, 1906, **06**, 804.

ONEMILE CREEK, Ala. (Dr.) **08**, 865.

ONTONAGON R., Ontonagon, Mich. (S.) (Chicago, Milwaukee & St. Paul Ry. Co.) PLANS.—Approv. June 13, 1904, **04**, 719.

OOSTENAULA and COOSAWATEE RS., Ga. (A.) (2 R. R. and 2 county brs.) PLANS.—Brs. without a draw, and the ps. are too low, **89**, 2797.

OOSTENAULA R., Ga. (Dr.) **06**, 797.

OOSTENAULA R., Ga. (S.) (Southern Ry. Co.) PLANS.—Rebuilding approv. June 9, 1906, **06**, 807.

OOSTENAULA R., Gordons Ferry, Millers Ferry, and Printups Ferry, Ga. (S.) (Gordon County brs.) PLANS.—Approv. Nov. 18, 1904, **05**, 725.

OOSTENAULA R., Millers Ferry, Ga. (S.) (Gordon County br.) PLANS.—Approv. Mar. 12, 1912, **12**, 1306.

OPELOUSAS B., St. Martins Parish, La. (S.) (Morgan's Louisiana & Texas R. R. & S. S. Co.) PLANS.—Approv. May 23, 1906, **06**, 807.

ORANGE R., Buckingham Post Office, Fla. (S.) (Lee County br.) PLANS.—Br. to replace existing str. approv. Jan. 23, 1904, **04**, 716.

OREGON SLOUGH. (See Columbia R.)

ORONOKEN CREEK, Beaver Dam, N. J. (S.) (Bridgeton & Millville Traction Co.) PLANS.—Approv. Jan. 17, 1902, **02**, 586.

ORRS ISLAND and GREAT ISLAND, Me. (tidewater between). (S.) (Harpswell town br.) PLANS.—Reconstr. of existing br. approv. May 23, 1912, **12**, 1307.

OSAGE R., Mo. (S.) (St. Louis, Kansas City & Colorado R. R. Co.) PLANS.—Approv. Sept. 21, 1901, **02**, 585.

OSAGE R., near Linn Creek, Mo. (S.) (Linn Creek Br. Co.) PLANS.—Approv. May 5, 1909, **09**, 918.

OSAGE R., Osceola, Mo. (S.) (Kansas City, Osceola & Southern Ry. Co.) PLANS.—Approv. Nov. 23, 1896, on condition that the company constr. a pivot p. whenever so directed, **97**, 531.

OSAGE R., Tuscumbia, Mo. (S.) (Tuscumbia Br. Co.) PLANS.—Approv. Aug. 8, 1904, **05**, 723.

OSWEGO R., Oswego, N. Y. (S.) (City br.) PLANS.—Reconstr. approv. Nov. 17, 1908, **09**, 916.

OSWEGO R., Oswego, N. Y. (S.) (City br.) PLANS.—Reconstr. approv. Apr. 15, 1909, **09**, 917.

OSWEGO R., Oswego, N. Y. (S.) (New York Central & Hudson River R. R. Co.) PLANS.—Reconstr. approv. June 27, 1911, **11**, 1090.

OTTAWA R., Ohio. (S.) (Toledo, Ottawa Beach & Northern Ry. Co.) PLANS.—Approv. Feb. 23, 1911, **11**, 1087.

OUACHITA R., Ark. (Sp.) (Rock Island, Arkansas & Louisiana R. R. Co.) Au. act Dec. 15, 1905. PLANS.—Approv. Jan. 11, 1906, **06**, 799.

OUACHITA R., between Ashley and Union Counties, Ark. (Sp.) (Eldorado & Bastrop Ry. Co.) Au. act Mar. 24, 1902. PLANS.—Approv. Oct. 9, 1902. **03,** 643.

OUACHITA and ARKANSAS RS., Camden and Pine Bluff, Ark. (Sp.) **83,** 271, 1606. LEGISLATION.—Br. au. act June 27, 1882, **83,** 271. PLANS.—Description of, **83,** 1605. Location of br. 10 m. below point specified in act June 27, 1882, **83,** 1606. Brs. partly completed before passage of act, **83,** 1607. Draw-span openings across Ouachita R. only 110′ in place of 130′, as required, **83,** 1607. Recom. by Capt. Handbury, that the matter of the length of drawbr. opening be allowed to remain in abeyance, **83,** 1609. Approv. by Sec. of War, **83,** 1610.

OUACHITA R., Camden, Ark. (Sp.) (Ouachita County br.) Au. act Mar. 2, 1911. PLANS.—Approv. Nov. 24, 1911, **12,** 1297.

OUACHITA R., near Columbia, La. (Sp.) (Houston, Central Arkansas & Northern R. R. Co.) LEGISLATION.—Company au. to constr. br. by act Aug. 6, 1888; amending act Aug. 18, 1890. PLANS.—Amended plan approv. Nov. 25, 1890, **91,** 430.

OUACHITA R., at Columbia, Caldwell Parish, La. (Sp.) (Caldwell Parish br.) Au. act Jan. 18, 1905. PLANS.—Approv. Apr. 27, 1905, **05,** 721.

OUACHITA R., Desiard Street, Monroe, La. (Sp.) (City br.) LEGISLATION.—City au. to constr. br. by act Feb. 8, 1897, **97,** 530. PLANS.—Approv. July 2, 1897, **97,** 530. Plans for constr. of timber cribwork between Monroe City br. and the Vicksburg, Shreveport & Pacific Ry. br., submitted Sept. 6, 1897; approv. Sept. 18, 1897, **98,** 531.

OUACHITA R., Monroe, La. (S.) (Vicksburg, Shreveport & Pacific Ry. Co.) PLANS.—Reconstr. approv. July 19, 1906, **07,** 820.

OUACHITA R., between town of Ouachita and mouth of Bayou Loutre, La. (Sp.) (Little Rock & Monroe Ry. Co.) Au. act Feb. 26, 1904. PLANS.—Approv. May 24, 1904, **04,** 712.

OVERPECK CREEK, Little Ferry, N. J. (S.) (West Shore R. R. Co. and New York Central & Hudson River R. R. Co.) PLANS.—Reconstr. approv. Feb. 7, 1902, **02,** 587.

OVERPECK CREEK, Ridgefield, N. J. (S.) (Bergen Turnpike Co.) PLANS.—Approv. Aug. 29, 1901, **02,** 584.

OVERPECK CREEK, Ridgefield Park, N. J. (O.) (New York, Susquehanna & Western R. R. Co.) PLANS.—Alterations to be completed on or before July 1, 1907, **07,** 829.

OYSTER R. (See Stony Creek, Conn.)

OYSTER CREEK, near Keyport, N. J. (O.) (Monmouth County br.) PLANS.—Alterations to be completed on or before 6 months from May 3, 1906, **06,** 809.

P.

PABLO CREEK, Fla. (O.) (Duval County br.) PLANS.—Br. to be raised 3′, and to have a 25′ opening on or before Sept. 1, 1899, **99,** 625.

PABLO CREEK, Fla. (O.) (Jacksonville & Atlantic Ry. Co.) PLANS.—Br. to be raised 3′, and to have a 25′ opening, on or before Sept. 1, 1899, **99,** 625.

PABLO CREEK, Fla. (O.) (Jacksonville, Mayport & Pablo Ry. Co.) PLANS.—Br. to be raised 3′, and to have a 25′ opening, on or before Sept. 1, 1899, **99,** 625.

PABLO CREEK, Duval County, Fla. (O.) (Duval County br.) PLANS.—Alterations to be completed on or before 4 months from May 1, 1909, **09,** 920.

PABLO CREEK, in Duval County, Fla. (S.) (Florida East Coast Ry. Co.) PLANS.—For alteration of central br. approv. Aug. 4, 1909, and modification thereof approv. Apr. 7, 1910, **10,** 1029.

PABLO CREEK (cut-off or canal connecting portions of it), Fla. (S.) (Florida East Coast Ry. Co.) PLANS.—Approv. Apr. 28, 1911, **11,** 1088.

PACHECO, ALHAMBRA, and **CODELIA SLOUGHS,** Cal. (S.) (Southern Pacific R. R. Co.) PLANS.—Reconstr. plans for brs. at these places approv. May 1, 1899, **99,** 622.

PAMLICO R., N. C. (A.) (1 R. R. and 3 county brs.) PLANS.—R. R. and 3 county brs. slightly interfere with navigation; would probably be provided with draws, should C. demand it, **89,** 2796.

PALIX R. (sec. 15, T. 13 N., R. 10 W., Willamette meridian), Wash. (S.) (Pacific County br.) PLANS.—Approv. June 2, 1911, **11,** 1089.

PAMLICO R., Washington, N. C. (S.) (Raleigh & Pamlico Sound R. R. Co.) PLANS.—Approv. Mar. 23, 1906, **06,** 805.

PAMLICO (Tar) **R.,** Washington, N. C. (S.) (Beaufort County br.) PLANS.—Rebuilding approv. Nov. 16, 1907, **08,** 871.

PAMUNKEY R. and **MABSCO CREEK,** Va., White House. (A.) (Richmond & Danville and Alexandria & Fredericksburg R. R. Cos.) PLANS.—Draws too narrow, and vessels passing are swept against the sides, **88,** 2621.

PAMUNKEY R., New Castle Ferry, Va. (S.) (King William County br.) PLANS.—Modified plans approv. May 20, 1899, **99,** 622, 623.

PANTEGO CREEK. (See Pungo Creek.)

PARADISE CREEK, Va. (Dr.) **02,** 581.

PARSONAGE CREEK, near Baldwins, Long Isld., N. Y. (O.) (Hempstead town br.) PLANS.—Alterations to be completed on or before 1 month from July 1, 1904; subsequently extended 6 months, **04,** 723. Alterations to be completed on or before 2 months from May 31, 1906, **06,** 809.

PASCAGOULA R., Jackson County, Miss. (S.) (Mobile, Jackson & Kansas City R. R. Co.) PLANS.—Approv. Sept. 10, 1895, **96,** 424.

PASCAGOULA R., Merrill, Miss. (S.) (Mobile, Jackson & Kansas City R. R. Co.) PLANS.—Modified plans approv. Sept. 9, 1901, **02,** 585.

PASCAGOULA R., Miss. (Dr.) **06,** 797; **08,** 865.

PASQUOTANK R., N. C. (S.) (Norfolk & Southern R. R. Co.) PLANS.—Rebuilding approv. Mar. 7, 1902, **02,** 587.

PASQUOTANK R., at Elizabeth City, N. C. (S.) (Camden Ferry Co.) PLANS.—Approv. Feb. 24, 1910, **10,** 1027.

PASSAGASSAWAUKEAG R., Belfast, Me. (S.) (Northern Maine Seaport Ry. Co.) PLANS.—Approv. June 27, 1905, **05,** 728.

PASSAIC R., N. J. (Dr.) **10,** 1019.

PASSAIC R., N. J. (S.) (New York Bay R. R. Co.) PLANS.—Approv. Mar. 31, 1900, **00,** 701.

PASSAIC R., N. J., and **NEWARK B.,** N. J. (Dr.) **02,** 581.

PASSAIC R., N. J. (S.) (Newark Plank Road Co.) PLANS.—Rebuilding approv. Apr. 11, 1901, **01,** 666.

PASSAIC R., N. J. (S.) (Central R. R. of New Jersey.) PLANS.—Approv. June 19, 1911. Temporary br. for use during reconstr. of existing br. approv. July 7, 1911, **12,** 1299. Instrument canceled Mar. 22, 1912. New plans approv. Mar. 22, 1912. **12,** 1300.

PASSAIC R., Avondale, N. J. (S.) (Br. of Bergen and Essex Counties.) PLANS.—Rebuilding approv. Mar. 12, 1904, **04,** 717.

PASSAIC R., Delawanna, Rutherford, and Lyndhurst, N. J. (O.) (Br. of Passaic and Bergen Counties.) PLANS.—Alterations to be completed on or before 3 years from June 29 and 30, 1906, **06,** 810.

PASSAIC R., Essex and Hudson Counties, N. J. (S.) (Br. of Essex and Hudson Counties—Newark Plank Road br.) PLANS.—Reconstr. approv. May 18, 1909, **09,** 918.

PASSAIC R., Newark, N. J. (S.) (Morris & Essex R. R. Co.) PLANS.—Rebuilding approv. Feb. 5, 1902, **02,** 586, 587.

PASSAIC R. (Center Street br.), at Newark and Harrison, N. J. (S.) (Pennsylvania R. R. Co., lessee of the United New Jersey R. R. & Canal Co.) PLANS.—Br. to replace existing str. approv. Apr. 6, 1910, **10,** 1029.

PASSAIC R., from Bridge Street, Newark, to Harrison Avenue, Harrison, N. J. (S.) (Br. of Hudson and Essex Counties, N. J.) PLANS.—Reconstr. of existing br. approv. July 10, 1911, **12,** 1299.

PASSAIC R. (Belleville br.), between Newark and Passaic, N. J. (S.) (Br. of Bergen, Essex, and Hudson Counties.) PLANS.—Reconstr. approv. May 25, 1912, **12,** 1307.

PASSAIC R., Newark, N. J. (S.) (Erie R. R. Co.) PLANS.—Reconstr. plans approv. Sept. 16, 1897, **98,** 533.

PASSAIC R., Passaic, N. J. (S.) (Passaic and Bergen Counties br.) PLANS.—Submitted May 11, 1894; modified May 24 1894; approv. May 31, 1894, **94,** 428.

PASSAIC R., Passaic, N. J. (S.) (Br. of Bergen and Passaic Counties.) PLANS.—Approv. Feb. 10, 1904, **04,** 716.

PASSAIC R., Passaic, N. J. (S.) (Jersey City, Hoboken & Paterson Street Ry. Co.—temporary.) PLANS.—Approv. Apr. 25, 1904, **04,** 718.

PASSAIC R., Passaic and East Passaic, N. J. (S.) (Brs. of Essex and Hudson Counties.) PLANS.—Reconstr. and temporary footbr. approv. July 26, 1906, **07,** 820.

PASSAIC R., Rutherford, N. J. (S.) (Bergen and Passaic Counties br.) PLANS.—Modified plans approv. Aug. 14, 1896, **96,** 427.

PATAPSCO R., Middle Branch, Spring Garden, Baltimore, Md. (S.) (Western Maryland Tidewater R. R. Co.) PLANS.—Approv. Feb. 13, 1903, **03,** 649.

PATCHOGUE R. (See Stony Creek, Conn.)

PATCONG CREEK, Steelmanville, Atlantic County, N. J. (O.) (Atlantic County br.) PLANS.—Alterations to be completed on or before Sept. 3, 1903, **03,** 651.

PATCONG (Cedar Swamp) **CREEK,** Steelmanville, N. J. (O. and A.) (Atlantic County br.) PLANS.—Reconstr. approv. June 13, 1904, **04,** 720.

PATCONG CREEK, Steelmanville, N. J. (S.) (Atlantic County br.) PLANS.—Reconstr. of existing br. approv. Nov. 10, 1911. **12,** 1302.

PATUXENT R., Mount Calvert, near Bristol Landing, Md. (S. and Sp.) (Washington & Chesapeake Beach Ry. Co.) LEGISLATION.—Company au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Maryland, **92,** 405. PLANS.—Orig. plan approv. Apr. 26, 1892, **92,** 405. On Mar. 30, 1894, the company submitted plans for modification in constr. of draw and center p.; approv. Apr. 3, 1894, **94,** 426.

PAW PAW R., Mich. (A.) (2 R. R. brs.) PLANS.—2 R. R. brs. slightly obstr. navigation, **89,** 2802.

PAW PAW R., near Benton H., Mich. (O.) (Cleveland, Cincinnati, Chicago & St. Louis Ry. Co.) PLANS.—Specified alterations to be completed on or before Apr. 1, 1902, **02,** 590, 591.

PAW PAW R., near Benton H., Mich. (O.) (City of Benton H. and township of Benton—2 brs.) PLANS.—Specified alterations to be completed on or before Apr. 1, 1902, **02,** 591.

PAW PAW R., Benton H., Mich. (O. and A.) (Cleveland, Cincinnati, Chicago & St. Louis Ry. Co.) PLANS.—Specified alterations to be completed within 6 months from Mar. 11, 1901, **01,** 668.

PAW PAW R., Benton H., Mich. (O. and A.) (Pere Marquette R. R. Co.) PLANS.—Alterations to be completed within 6 months from Mar. 18. 1901, **01,** 668.

PAW PAW R., near Benton H., Mich. (A.) (Cleveland, Cincinnati, Chicago & St. Louis Ry. Co.) PLANS.—Reconstr. in accordance with requirements approv. Dec. 20, 1901, **02,** 590.

PAW PAW R., near Benton H., Mich. (O.) (Pere Marquette R. R. Co.—2 brs.) PLANS.—Alterations to be completed on or before Apr. 1, 1902, **02,** 591.

PAW PAW R., Benton H. and Benton, Mich. (O. and A.) (City brs.) PLANS.—Alterations to be completed within 6 months from Mar. 11, 1901, **01,** 668.

PAWTUCKET R., Providence, R. I. (A.) **88,** 2528. LEGISLATION.—Act of State Legislature, Jan., 1883, requiring reconstr. of the br. with a swing draw, with openings on each side of 80′, **88,** 2529. PLANS.—New br. in process of constr., **88,** 2529.

PAWTUCKET R., R. I. (A.) (Boston & Providence R. R. Co.) **88,** 2529. COMMERCE.—Obstr. caused by the br. to C. of Pawtucket, **88,** 2529. LEGISLATION.—Resolution of State Legislature, May 29, 1884, appointing a committee to R. upon brs. obstr. the R., **88,** 2530. PLANS.—Description of the br., **88,** 2529. Lt. Col. Elliott R. the available draw opening too narrow and that there should be 2, **88,** 2530.

PAWTUCKET R., R. I. (Dr.) **11,** 1078.

PAWTUCKET R. (See Seeconk R.)

PAWTUCKET (Seeconk) **R.,** Indian Pt., Providence, R. I. (S.) (New York, New Haven & Hartford R. R. Co.) PLANS.—Reconstr. approv. Feb. 14, 1902, **02,** 587.

PEACE R. (See Withlacoochee R.)

PEARL R., Miss. (Sp.) (Marion County br.) LEGISLATION.—County au. to constr. br. by act June 18, 1897. PLANS.—Approv. July 1, 1897, **97,** 530.

PEARL R., Miss. (Sp.) (Mississippi Central R. R. Co.) Au. act Jan. 18, 1905. PLANS.—Approv. Sept. 14, 1905, **06,** 799.

PEARL R., Carthage, Miss. (S.) (Leake County br.) PLANS.—Rebuilding approv. Sept. 30, 1908, **09,** 915.

PEARL R., Marion County, Miss. (Sp.) (New Orleans Great Northern R. R. Co.) Au. act Feb. 25, 1907. PLANS.—Approv. Nov. 6, 1907, **08,** 866.

PEEKSKILL B., Peekskill, N. Y. (S.) (New York Central & Hudson River R. R. Co.) PLANS.—Reconstr. of center p. of draw span approv. Apr. 11, 1902, **02,** 588.

PENASOFFKEE OUTLET, connecting Penasoffkee Lake with the Withlacoochee R., Fla. (S.) (Sumter County br.) PLANS.—Approv. Nov. 22, 1909, **10,** 1025.

PEND OREILLE R., Standpoint, Idaho. (Sp.) (Spokane International Ry. Co.) Au. act Feb. 18, 1905. PLANS.—Approv. Oct. 19, 1905, **06,** 799.

PEND OREILLE R., near Box Canyon, Stephens County, Wash. (Sp.) (Idaho & Washington R. R. Co.) Au. act Aug. 16, 1911. PLANS.—Approv. Oct. 3, 1911, **12,** 1296.

PENNYPACK CREEK, Torresdale Avenue, Philadelphia, Pa. (S.) (City br.) PLANS.—Approv. June 23, 1894, **94,** 429.

PENSAUKEN CREEK. (See Schuylkill R.)

PENSAUKEN CREEK, N. J. (S.) (Camden & Suburban Ry. Co.) PLANS.—Approv. May 20, 1904, **04,** 719.

PEQUONNOCK R., Bridgeport, Conn. (S.) (New York, New Haven & Hartford R. R. Co.) PLANS.—Submitted Apr. 15, 1896, objectionable; modified plans submitted Nov. 10, 1896; approv. Dec. 10, 1896, **97,** 533.

PERDIDO R., near Holman Ferry, Fla. and Ala. (Sp.) (Escambia County, Fla., and Baldwin County, Ala., br.) LEGISLATION.—Counties au. to constr. br. by act Aug. 13, 1894, **95,** 474. PLANS.—Approv. Dec. 5, 1894. Br. completed. **95,** 474.

PETALUMA CREEK, Marion County, Cal. (S.) (Bay Counties Ry. Co.) PLANS.—Approv. Feb. 14, 1906, the instrument of approv. being modified by instrument dated Mar. 8, 1906, **06,** 804.

PETALUMA CREEK, near Petaluma, Cal. (S.) (San Francisco & North Pacific Ry. Co.) PLANS.—Approv. Nov. 21, 1903, **04,** 715.

PETALUMA CREEK, Sonoma County, Cal. (S.) (Northwestern Pacific R. R. Co.) PLANS.—Approv. June 3, 1911, **11,** 1089.

PETIT JEAN, CACHE, ST. FRANCIS, ARKANSAS, SALINE, and **POTEAU RS.** (A.) PLANS.—Brs. interfere with present or prospective imp. of the streams, **88,** 2635.

PIKE CREEK, Main Street, Kenosha, Wis. (S.) (City br.) PLANS.—Approv. June 14, 1901, **01,** 667.

PINE ISLAND BAYOU, near Beaumont, Tex. (O.) (Gulf, Colorado & Santa Fe Ry. Co.) PLANS.—Alterations to be completed on or before 6 months from July 16, 1908, **09,** 919.

PINE LAKE, near Charlevoix, Mich. (Sp.) (Chicago & North Michigan R. R. Co.) LEGISLATION.—Company au. to constr. br. under act Sept. 19, sec. 7, Michigan laws, and assent of board of supervisors, Charlevoix County, Mich. PLANS.—Approv. Sept. 4, 1891, **91,** 432.

PINE LAKE (s. arm of), S. Arm, Mich. (S.) (Town br.) PLANS.—Reconstr. approv. May 1, 1901, **01,** 666.

PINE R., St. Clair, Mich. (S.) (Rapid Ry. Co.) PLANS.—Reconstr. plans approv. July 3, 1899, **99,** 623.

PINE R., Charlevoix, Mich. (S.) (Town br.) PLANS.—Approv. Mar. 19, 1901, **01,** 665.

PISCATAQUA R., Dover Pt., N. H. (S.) (Boston & Maine R. R. Co.) PLANS.—Reconstr. approv. May 6, 1907, **07,** 827.

PISCATAQUA R., chan. between Kittery and Badgers Isld., Me. (S.) (Portsmouth, Kittery & York Street Ry. Co.) PLANS.—Approv. June 18, 1897, **97,** 534.

PISCATAQUA R., at U. S. Navy Yard, between Portsmouth, N. H., and Kittery, Me. (Sp.) (Navy Dept. br.) Au. act Mar. 4, 1911. PLANS.—Approv. Oct. 30, 1911, **12,** 1296.

PISCATAWAY CREEK, Essex County, Va. (S.) (Essex County br.) PLANS.—Rebuilding approv. Nov. 4, 1908, **09,** 916.

PLAQUEMINE BAYOU, La. (O.) (Texas & Pacific Ry. Co.) PLANS.—Specified alterations required on or before Apr. 15. 1892, **91,** 434.

PLAQUEMINE BAYOU, Iberville, La. (O. and A.) (Iberville Parish br.) PLANS.—Alterations to be completed on or before Nov. 1 1901, **01,** 668.

PLAQUEMINE BAYOU, Plaquemine, La. (S.) (Iberville Parish br.) PLANS.—Approv. Aug. 31, 1897, **97,** 535. General plans approv. Mar. 25, 1907, **07,** 826. Detailed plans approv. Aug. 22, 1907, **08,** 869. Notice dated Mar. 5, 1909, was given to remove cofferdam around s. p. within 30 days from date of service of notice, **09,** 919.

PLAQUEMINE BRULE BAYOU, La. (S.) (Morgan's Louisiana & Texas R. R. & S. S. Co.) PLANS.—Reconstr. plans approv. Jan. 21, 1911, **11,** 1085.

POCOMOKE R. (See Christiana R., Wilmington, Del.)

POINT JUDITH POND (entrance to), South Kingston, R. I. (S.) (Sea View R. R. Co.) PLANS.—Approv. Feb. 14, 1906, **06,** 804.

POINT PLEASANT and **CARLOWS ISLD.** (chan. between), Me. (O.) (Washington County R. R. Co.) PLANS.—Alterations to be completed on or before Dec. 31, 1904, **03,** 652.

POQUONNOCK R., Bridgeport, Conn. (S.) (Congress Street Br. Commission.) PLANS.—Br. to replace existing str. approv. Aug. 12, 1908, **09,** 914.

PORTAGE CANAL, connecting Fox and Wisconsin Rs. near Portage City, Wis. (Sp., etc.) (See Fox R.) (Chicago, Milwaukee & St. Paul Ry. Co.) PLANS.—New br. approv. Jan. 20, 1892, **92,** 403.

PORTAGE LAKE, between Houghton and Hancock, Mich. (Sp.) (Mineral Range R. R. Co.) LEGISLATION.—Company au. to constr. br. by act Mar. 3, 1891, **99,** 618. PLANS.—As per request in company's letter of Dec. 10, 1897, permission was given, Mar. 1, 1898, to rebuild the drawbr., **98**, 537. Reconstr. plans approv. Sept. 15, 1898, **99**, 618.

PORTAGE LAKE, Houghton and Hancock, Mich. (Sp.) (Houghton County br.) PLANS.—Reconstr. approv. Jan. 7, 1901, **01**, 664. Rebuilding approv. Jan. 7, 1901. Reconstr. Houghton approach by the Copper Range Ry. Co. approv. Mar. 20, 1902. **02**, 582.

PORTAGE LAKE, Houghton, Mich. (S.) (Mineral Range R. R. Co.) PLANS.—Reinforcement of existing br. approv. Dec. 27. 1911, **12**, 1303.

PORTAGE R., Oak H., Ohio. (S.) (Toledo Port Clinton & Lakeside Ry. Co.) PLANS.—Approv. Aug. 17, 1903, **04**, 714.

PORTAGE R., near Port Clinton, Ohio. (S.) (Lake Shore & Michigan Southern Ry. Co.) PLANS.—Br. to replace existing str. approv. Feb. 21, 1910, **10**, 1027. Temporary br. during constr. of permanent br. approv. Nov. 28, 1911, **12**, 1303.

PORTLAND H., Back Cove, Me. (Dr.) **02**, 581.

PORTLAND H., entrance to Back Cove, Me. (O. and A.) (Portland City br. ("Turkey's"—Tukey—br.), highway.) PLANS.—Specified alterations required on or before Dec. 31, 1894, but on account of interference with dr. work, time extended to Dec. 31, 1895, and to Dec. 31, 1896, **95**, 482. Reconstr. plans approv. Feb. 10, 1897; modified plans, reducing the draw opening from 70 to 67′, approv. May 26, 1897, **97**, 535. Alterations to be completed on or before July 1, 1901, **01**, 668.

PORTLAND H., Me. (See Fore R. mouth.)

PORTLAND H., Me. (S.) (Portland & Cape Elizabeth Ry. Co.) PLANS.—Approv. Oct. 4, 1898, **99**, 621.

PORTLAND H. (entrance to Back Cove), Me. (S.) (Grand Trunk Ry. system.) PLANS.—Reconstr. of existing br. approv. Mar. 27, 1912, **12**, 1306.

PORTSMOUTH H., Portsmouth Navy Yard, N. H., and Kittery, Me. (S.) (Navy Dept. br.) PLANS.—Approv. Jan. 14, 1901, **01**, 664.

POTEAU R., Choctaw Nation, near Fort Smith, Ark. (Sp.) (Fort Smith & Choctaw Br. Co.) LEGISLATION.—Company au. to constr. br. by acts June 18, 1888, and Mar. 2, 1889. PLANS.—Approv. June 18, 1889, **89**, 372.

POTOMAC R. (See Miscellaneous Index, page 2040 of this index.)

POTOMAC R., E. Branch of. (See Anacostia R.)

POTOMAC R. (Long Br.) ENGINEERS.—Engineers in charge: Maj. N. Michler, 1867-71. **Rs.**, **67**, 521; **68**, 891; **69**, 494; **70**, 519; **71**, 974. Maj. O. E. Babcock, 1871. **R.**, **71**, 969. Maj. P. C. Hains, 1883-91. **Rs.**, **83**, 783; **84**, 976; **85**, 936; **86**, 886; **87**, 888; (Lt. Col.) **88**, 782; **89**, 986; **90**, 1040, 1042; **91**, 1248. Maj. C. E. L. B. Davis, 1892. **R.**, **92**, 1036. LEGISLATION.—D. C. br. acts for 1805-1869, **69**, 519. Acts Feb. 5, 1868, and June 21, 1870, transferred possession of Long Br. to the Baltimore & Potomac R. R. Co., subject to certain conditions, **70**, 519. OPERATIONS.—**1868.** New draw built and minor repairs made, **68**, 891. **1869-70.** Floor renewed and minor repairs made, **70**, 519. **1870-71.** Br. damaged by a freshet, 1870; reconstr. by company, **71**, 974. **1891-92.** Br. rebuilt, **92**, 1036. PLANS.—Baltimore & Potomac R. R. Co. submitted plans for reconstr. of that part of Long Br. over Washington chan., approv. July 28, 1891, **92**, 1036. PROJECTS.—Br. built in 1808. History and description. **67**, 521; **83**, 783; **88**, 2539; **90**, 1042. Maj. Hains est., 1883, about $1,500,000 to rebuild the br., **83**, 785. Conditions, 1884. Obstr. to further imp. of Potomac R., **88**, 2539. Br. a constant menace to Washington during season of ice, **87**, 889. Lt. Col. Hains est., 1890, it would cost $1,250,000 for separation of the wagon road from the R. R. on the n. side of the main chan. and the reconstr. of the br. over the main chan. of the R. on wider spans, **90**, 1044. SURVEYS.—Investigation of the desirability of separating the wagon road from the R. R. on the n. side of the main chan. of the Potomac R., with est., au. by Senate's resolution, dated Mar. 7, 1890; **R.** made, 1890, by Lt. Col. Hains (see Projects), **90**, 1042.

POTOMAC R., D. C. (Dr.) **10**, 1019.

POTOMAC R. (Aqueduct Br.), Georgetown, D. C. APPROPRIATIONS.—1886, $240,000, **88**, 789. COMMERCE.—Br. an obstr. to C. interests of R., **88**, 2541. CONTRACTS.—**1888.** C. Thomas, watchman's house and wooden sidewalk constr., $495 for the first, and $2.25 per l. f. for the second, **88**, 795. Breen & Feely, embankment constr., 25½¢ per c. y., and slope paving, 45½¢ to $1.34 per s. y., **88**, 796. ENGINEERS.—Chief of Engineers. **R.**, **76**, 66, 331. **Rs.** on condition of br. in 1886, **86**, 148; **87**, 898; **88**, 106; **89**, 123. Engineer in charge: Maj. W. P. Craighill, 1876. **R.**, **76**, 331. Lt. Col. P. C. Hains, 1886-89. **Rs.**, **88**, 789, 2541; **89**, 989. Assistant: Lt. T. Turtle. **R.**, **76**, 332. LEGISLATION.—History of, **86**, 931. Senate resolution of Feb. 25, 1886, calling for an ex. of condition of br. and its safety when the aqueduct is filled with water, **86**, 148. Purchase and reconstr. of br. au. by act June 21, 1886, **88**, 789, 790. OPERATIONS.—**1887-88.** Removal of old and erection of new br. nearly completed, **88**, 792. **1888-89.** Reconstr. work completed, **89**, 989, 990. PLANS.—General description of, **86**, 932. Condition of br. in 1886, **86**, 933. Repairs required, **86**, 947. General features of proposed reconstr., **88**, 790. Recom. br. as an aqueduct be discontinued and that draw be provided, **88**, 2541, 2542. PROJECTS.—Description of br., **76**, 332. SURVEYS.—Ex., with **R.** upon the condition of the Aqueduct Br. over the Potomac R., au. by Senate's resolution, Feb. 3, 1876; made, 1876, by Maj. Craighill (**R.** fav. to thorough repair and adjustment), **76**, 332. Maps. **76**, 332.

POTOMAC R., Georgetown, D. C. (Leased by the Alexandria Canal Co.) APPROPRIATIONS.—1894,[1] $51,070, **95,** 4099. 1896, $65,000, **96,** 3886. Total, $116,070. CONTRACTS.—**1894.** Shailer & Schniglau Co., repairing br., $33,765, **95,** 4092. **1897.** Houston Contracting Co., reconstr. p. No. 4, $29,997.50, **97,** 3990. Contract annulled May 27, 1898, **98,** 3573. ENGINEERS.—Chief of Engineers. **Rs.,** **95,** 484; **96,** 429; **97,** 536; **98,** 539; **99,** 626; **00,** 703. Engineers in charge: Maj. N. Michler, 1868–71. **Rs.,** **68,** 892; **69,** 495; **70,** 519; **71,** 975. Maj. C. E. L. B. Davis, 1895. **R.,** **95,** 4085. Maj. C. J. Allen, 1896–1900. **Rs.,** **96,** 3883, 3887; (Lt. Col.) **97,** 3987; **98,** 3571; **99,** 3777; **00,** 5123. LEGISLATION.—Au. by act July 27, 1868, **68,** 892. OPERATIONS.—**1869.** Br. completed and opened to the public, **69,** 495. **1894–96.** Br. repaired, **95,** 4094; **96,** 3884. **1896–97.** Reconstr. of p. No. 4 in progress, **97,** 3988. **1897–98.** Reconstr. of p. No. 4 continued, but because of war with Spain work was suspended and contractor requested to block up p. and make br. as stable as possible. As the contractor refused to comply, the work was done with hired labor. **98,** 3573. **1899–00.** Work in progress on p. No. 4, **00,** 5124. PROJECTS.—Maj. Davis est., 1893, $51,070 to make the necessary repairs to the br., **95,** 4090. Maj. Allen est., 1895, $65,000 to reconstr. p. No. 4, **96,** 3888. SURVEYS.—Ex. of the ps. of the Aqueduct Br., with statement of expend. made since it became joint property of the U. S. and D. C., au. by Senate's resolution of Jan. 21, 1893; **R.** made, 1895, by Maj. Davis (see Projects), **95,** 4085.

POTOMAC R., Georgetown, about 3 m. above. (Little Falls Br., Chain.) ENGINEERS.—Engineers in charge: Maj. N. Michler, 1867–71. **Rs.,** **67,** 521; **68,** 892; **69,** 495; **70,** 520; **71,** 975. Maj. O. E. Babcock, 1871–77. **Rs.,** **71,** 969; (Col.) **76,** ii, 690; **77,** ii, 1066. OPERATIONS.—**1869.** 2 spans rebuilt, 8 others repaired, and minor work done, **69,** 495. **1870–71.** Damaged by freshet, 1870, repaired, **71,** 969. **1875–76.** Repairs made, **76,** ii, 690. PROJECTS.—Br. in a dilapidated condition and only by the most careful attention on the part of the watchman could accidents be avoided, **67,** 521. TRAFFIC.—Large quantities of produce and thousands of head of cattle reach the Georgetown and Washington markets by this br., **68,** 892.

POTOMAC R., Georgetown, D. C. (Sp.) (Proposed.) ENGINEERS.—Chief of Engineers. **Rs.,** **82,** 263, 2013; **87,** 104, 905. Engineers in charge: S. T. Abert, U. S. C. E. **Rs.,** **82,** 2014, 2022, 2027. Lt. Col. P. C. Hains. **R.,** **87,** 898. LEGISLATION.—Br. au. by act Feb. 23, 1881, Congress app. $140,000 therefor, **82,** 2012. Purchase of Aqueduct Br. au. at $85,000, but found to be impracticable, **82,** 2012, 2018. Recom. legislation, **86,** 931; **87,** 899. Act June 21, 1886, providing for purchase and reconstr. of br., **87,** 899. PLANS.—Location discussed, **82,** 2015, 2023. Requirements of brs., **82,** 2024, 2027, 2032. Proposals received, **82,** 2023, 2026. Est. of cost, **82,** 2032. General description of Aqueduct Br. completed in 1868, **86,** 932; **87,** 898. Plans of new br., **87,** 902–908.

POTOMAC R., Little Falls. (Iron.) APPROPRIATIONS.—1872, $100,000, **73,** 1159. CONTRACTS.—**1872.** S. R. Dickson, iron br. (bid within limit of app.), **73,** 1159. Contract annulled, **74,** ii, 392. **1873.** Clark, Reeves & Co., br., **74,** ii, 392. ENGINEERS.—Engineers in charge: Col. O. E. Babcock, 1873–77. **Rs.,** **73,** 110, 1159; **74,** ii, 392; **75,** ii, 813; **77,** ii, 1070. Lt. Col. T. L. Casey, 1880. **R.,** **80,** 2342. Col. A. F. Rockwell, 1881–84. **Rs.,** **81,** 2715; **82,** 2738; **83,** 2101; **84,** 2346. Lt. Col. J. M. Wilson, 1885–86. **Rs.,** **85,** 2509; **86,** 2085. OPERATIONS.—**1873.** Old wooden span of this br. removed by Canal Co., **73,** 1159. **1873–74.** Br. constr., **74,** ii, 392. **1874–75.** 1,504′ handrail placed and br. painted, **75,** ii, 813. **1880.** Br. painted and roadway removed, **80,** 2342. **1881–82.** Extensive repairs made, **81,** 2715; **82,** 2738. **1882–83.** Guard timbers renewed and painted, **83,** 2101. **1884–86.** Repairs made, **84,** 2346; **85,** 2509; **86,** 2085.

POTOMAC R., Shepherdstown, W. Va. (Sp.) (Norfolk & Western R. R. Co.) Au. act Feb. 5, 1907. PLANS.—Approv. June 26, 1907, **07,** 819.

POTOMAC R., Washington, D. C. (Memorial Br.) APPROPRIATIONS.—1899, $5,000, **99,** 3779 (sur.). ENGINEERS.—Chief of Engineers. **Rs.,** **86,** 892; **98,** 540; **99,** 42, 627; **00,** 43, 704. BE. constituted by S. O. No. 30, Feb. 5, 1900, to consider and report upon the relative merits of the plans submitted for a br. to be constr. over the Potomac R. at Washington, D. C., as a memorial to American patriotism. **R.,** **00,** 5127. (Lt. Col. C. J. Allen, Maj. T. W. Symons, Capt. D. D. Gaillard, and S. White and Jas. G. Hill.) Engineers in charge: Maj. P. C. Hains, 1885, 1890. **Rs.,** **86,** 892; (Lt. Col.) **90,** 1045. Lt. Col. C. J. Allen, 1898–. **Rs.,** **98,** 3573; **99,** 3779; **00,** 5125. PHYSICAL CHARACTERISTICS.—Description of borings for site of br., **98,** 3576. PROJECTS.—Maj. Hains est., 1886, it would cost $609,543 or $650,000 to build a br. over the Potomac R., **86,** 895. Capt. Symons est., 1886, $1,000,000 or $1,500,000 to build a br. over the Potomac R. from Observatory Hill to Arlington, **86,** 896. Lt. Col. Hains est., 1890, $3,591,000 to build a suspension br. at the place designated, **90,** 1047. Maj. Davis est., 1892, $803,990 to constr. a br., plans similar to the ones prepared by Col. Hains, 1896, **98,** 3592. Lt. Col. Allen est., 1898, $1,385,000 to build the br. at the place designated, **98,** 3598. Description of the main features of the various designs submitted for a memorial br., **00,** 5134–5142. BE., 1900, est. $4,860,000, or 32% more than Mr. Burr's est. ($3,680,672), by adopting Mr. Burr's design, with certain recom. and modifications, for a memorial br. across the Potomac R., **00,** 5146. SURVEYS.—Ex. as to the wisdom of constr. a U. S. br. with a suitable draw and approaches, from a point at or near the foot of New York or New Hampshire Avenue, on the public grounds, across the Potomac R. and Analostan Isld. to a point on the U. S. National Cemetery grounds at Arlington, with est., au. by Senate resolution May 24, 1886; R. made, 1886, by Maj. Hains (see Projects), **86**, 893. Ex. in regard to the most suitable kind of br. from foot of New York Avenue across the Potomac R. to Arlington, with est., au. by Senate resolution Feb. 20, 1890; R. made, 1890, by Lt. Col. Hains (see Projects), **90**, 1045. Under Senate bill 796, secs. 2 and 3, 52d Cong., 1st sess., Dec. 14, 1891, Maj. Davis was ordered to give his views in reference to the plans and specifications, and submit plan of the proposed br. between U. S. Naval Observatory grounds and Arlington estate property (see Projects), **98**, 3592. Necessary surs., soundings, and borings, and securing designs and ests. for a memorial br. from the most convenient point of the Naval Observatory grounds, Washington, D. C., or adjacent thereto, across the Potomac R. to the most convenient point of the Arlington estate property, Va., au. act June 4, 1897; made, 1898, by Lt. Col. Allen (R. fav. to a further study of the subject; see Projects), **98**, 3574. History of previous ex. for a memorial br., **98**, 3590. Continuing ex. for a memorial br. across the Potomac R., and making or securing designs, calculations, and ests. for same, from the most convenient point of the Naval Observatory grounds or adjacent thereto across the Potomac R. to the most convenient point of the Arlington estate property, au. act Mar. 3, 1899, **99**, 3779. Maps. **90**, 1046.

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[1] District of Columbia.

POTOMAC R., "Three Sisters," near Washington, D. C. (Sp., etc.) (Washington & Arlington Ry. Co.) LEGISLATION.—Company au. to constr. br. by act Feb. 28, 1891, **92**, 405. PLANS.—Approv. Apr. 27, 1892, **92**, 405.

POTOMAC R., Washington, D. C. (Sp.) (Baltimore & Potomac R. R. Co.—Long Br.) Au. act Feb. 12, 1901. PLANS.—Constr. of br. to replace existing str. approv. Oct. 25, 1901, **02**, 582.

POTOMAC R., between Long Br. and Aqueduct Br., Washington, D. C. (Sp.) (U. S. highway br.) Au. acts Feb. 12, 1901, and July 1, 1902. PLANS.—Location approv. Aug. 1, 1902, and plans approv. Jan. 13, 1903, **03**, 643.

POTOMAC R., E. Branch of the. (A.) APPROPRIATIONS.—1887, $110,000, **87**, 913. 1888, $60,000, **88**, 798. Total, $170,000. CONTRACTS.—**1887.** Broton Br. & Mfg. Co., br. constr., $105,000, **88**, 795. **1890.** W. Rothwell, watchman's house, $333; guard fence, $1.96 per s. y.; painting through spans, $549, and wooden sidewalk constr., $1.10 per l. f., **90**, 1050. W. H. Mohler, slope paving, $2 per s. y.; curbing, $1.48 per l. f.; gutters, 45¢ per s. y.; and riprap, 80¢ per c. y., **90**, 1050. ENGINEERS.—Chief of Engineers. Rs., **87**, 105, 340, 917; **88**, 106; **89**, 123; **90**, 110. BE. convened by S. O. No. 61, C. of E., 1887, to consider br. the E. Branch of the Potomac R. R., **87**, 923. (Lt. Cols. Wilson and Hains and Maj. Lydecker.) Engineer in charge: Lt. Col. P. C. Hains, 1887-90. Rs., **87**, 911; **88**, 795, 798; **89**, 990; **90**, 1048. LEGISLATION.—Alterations in plan of br. au. by act May 14, 1888, **88**, 797. OPERATIONS.—**1887-88.** Work begun on e. approach. Operations suspended pending settlement of controversy with Baltimore & Potomac R. R. Co. **88**, 796. **1888-89.** Operations resumed under amended plan, **89**, 992, 993. **1889-90.** Br. completed; unexpended balance, $14,000, used for necessary work not contracted for, **90**, 1049. PROJECTS.—Description of br., **87**, 912, 915, 918, 924; **88**, 796. SURVEYS.—Maps. **89**, 992.

POTOMAC R., Powder Mill Branch. (Wooden br.) **1878.** Br. having been washed away, was towed back and replaced, **78**, ii, 1351.

POTSBURY CREEK, Fla. (O.) (St. Johns County br.) PLANS.—Specified alterations required on or before June 1, 1894, were completed, **94**, 431.

POUTEAU R. (See Petit Jean R.)

POWELLS CREEK, Va. (Dr.) **07**, 815.

POWELLS R., near Agee Post Office, Tenn. (Sp.) (Campbell County br.) Au. act Feb. 20, 1908. PLANS.—Approv. Apr. 24, 1908, **08**, 867.

POWELLS CREEK. (See Neabsco Creek.)

POWOW R., between Amesbury and Salisbury, Mass. (Sp.) (Berlin Iron Br. Co., afterwards committed to the commissioners of Essex County.) **91**, 427. PLANS.—Berlin Iron Br. Co. submitted plan for draw 56′ wide, Mar. 11, 1889; approv. Mar. 23, 1889; being unsatisfactory to the towns, a plan for a leaf draw 35′ wide was approv. Apr. 10, 1889. Essex County commissioners submitted plan for a pivot draw, instead of the leaf draw, Aug. 25, 1890; approv. Sept. 2, 1890. **91**, 427.

PROVIDENCE R., Point Street, Providence, R. I. (S.) (City br.) PLANS.—Rebuilding approv. May 18, 1905, **05**, 727.

PUGET SOUND, LAKES UNION and WASHINGTON (waterway connecting). (S.) (Brs. of the city of Seattle, Wash.—2.) PLANS.—2 temporary brs. approv. May 4, 1910, **10**, 1029.

PUGET SOUND and LAKES UNION and WASHINGTON, waterway connecting at city of Seattle, near Rass Place and Jesse Avenue, Wash. (Crossing canal and occupation of U. S. property sanctioned, act Mar. 22, 1912.) (S.) (Northern Pacific Ry. Co.) PLANS.—Approv. Aug. 16, 1911, **12**, 1300.

PUGET SOUND and LAKE WASHINGTON CANAL, Fremont Avenue, Seattle, Wash. (S.) (Seattle Electric Co.) PLANS.—Reconstr. approv. May 29, 1902, **02**, 580. Temporary trestle approv. Oct. 6, 1910, **11**, 1083.

PUGET SOUND and LAKE WASHINGTON CANAL, at 13th Avenue, Seattle, Wash. (S.) (City br.) PLANS.—Constr. of draw approv. Oct. 27, 1909, and the instrument of approv. modified Nov. 30, 1909, **10**, 1025.

PUGET SOUND and LAKE WASHINGTON CANAL and SALMON B., near Main Street, Seattle, Wash. (S.) (Great Northern Ry. Co.) PLANS.—Approv. July 3, 1909, **10**, 1023.

PUNGO and **PANTEGO CREEKS,** N. C. (S.) (Beaufort County brs.) PLANS.—Approv. Sept. 20, 1907, **08,** 870.

PUNGO R., Bellhaven, N. C. (S.) (Norfolk & Southern R. R. Co.) PLANS.—Approv. Aug. 31, 1906, **07,** 821.

PUYALLUP R., Pierce County, Wash. (S.) (Seattle-Tacoma Interurban Ry.) PLANS.—Approv. Aug. 13, 1901, **02,** 584.

PUYALLUP R., Kelly Street, Puyallup, Wash. (S.) (Puget Sound Electric Ry.) PLANS.—Approv. Apr. 17, 1908, **08,** 872.

PUYALLUP R., near Tacoma, Wash. (S.) (Oregon & Washington R. R. Co.) PLANS.—Approv. Dec. 21, 1906. **Modified plans in lieu thereof** approv. Dec. 9, 1907. **08,** 871.

PUYALLUP R., Tacoma, Wash. (S.) (Milwaukee & Puget Sound Ry. Co.) PLANS.—Approv. Mar. 15, 1909, **09,** 917.

PUYALLUP R., S. 21st Street, Tacoma, Wash. (S.) (City br.) PLANS.—Approv. Feb. 9, 1903. **03,** 648.

PUYALLUP R., near Tacoma, Wash. (S.) (Oregon & Washington R. R. Co.) PLANS.—Approv. Dec. 21, 1906, **07,** 824.

PUYALLUP R., near Tacoma, Wash. (S.) (Chicago, Milwaukee & St. Paul Ry. Co.) PLANS.—Approv. July 16, 1906, **07,** 820.

PUYALLUP R., Tacoma, Wash. (S.) (City br.) PLANS.—Approv. May 29, 1901, **01,** 666.

PUYALLUP R., Tacoma, Wash. (S.) (Northern Pacific Ry. Co.) PLANS.—Approv. Apr. 17, 1906, **06,** 806.

PUYALLUP R., Tacoma, Wash. (S.) (Oregon-Washington R. R. & Navigation Co.) PLANS.—Approv. Dec. 9, 1907, and modified plans July 21, 1911. Instrument dated Dec. 9, 1907, canceled. **12,** 1300.

Q.

QUANTICO CREEK. (See Neabsco Creek.)

QUANTICO CREEK, Va. (Dr.) **07,** 815.

QUINCY B., Quincy, Ill. (S.) (Chicago, Burlington & Quincy R. R. Co.) PLANS.—Reconstr. plans approv. Nov. 20, 1897, **98,** 533.

QUINNIPIAC R. (See Coscob, etc.)

QUINNIPIAC R., Conn. (Dr.) **02,** 581.

QUINNIPIAC R., Grand Avenue Crossing, New Haven, Conn. (O.) (City br.) PLANS.—Requiring a draw span with 70′ opening, measured at right angles to the chan., to be completed on or before Dec. 31, 1896, **95,** 483.

QUINNIPIAC R., Middletown Avenue, New Haven, Conn. (S.) (Shore Line Electric Ry. Co. PLANS.—Approv. Feb. 7, 1911, **11,** 1086.

R.

RACCOON CREEK, N. J. (See Schuylkill R.)

RACCOON CREEK, Bridgeport, N. J. (S.) (Gloucester County br.) PLANS.—Br. to replace existing str. approv. Sept. 12, 1903, **04,** 714.

RACCOON CREEK, Swedesboro, N. J. (S.) (Gloucester County br.) PLANS.—Approv. May 31, 1911, **11,** 1089.

RAHWAY R., N. J. (S.) (Sound Shore R. R. Co.) PLANS.—Modified plans approv. Feb. 27, 1896, **96,** 426.

RAHWAY R., Middlesex and Union Counties, N. J. (S.) (New Jersey Short Line R. R. Co.) PLANS.—Approv. Aug. 22, 1905, **06,** 801.

RAHWAY R., Lawrence Street, Rahway, N. J. (S.) (Union County br.) PLANS.—Approv. May 23, 1912, **12,** 1307.

RAINY R., Minn. (Sp.) (Minnesota & Ontario Br. Co.) LEGISLATION.—Company au. to constr. br. by act Mar. 9, 1900. PLANS.—Approv. June 22, 1900, **00,** 699.

RAINY R., International Falls, Minn. (Sp.) (International Br. & Terminal Co.) Au. acts Feb. 7, 1903, and May 20, 1908. PLANS.—Approv. Sept. 1, 1909, **10,** 1020.

RAINY R., Pithers Pt., Itaska County, Minn. (Sp.) (Rainy River Br. Co.) Au. act Apr. 6, 1906. PLANS.—Approv. Jan. 8, 1907, **07,** 818.

RANCOCAS CREEK, Delanco, N. J. (S.) (Burlington County br.) PLANS.—Reconstr. plans approv. June 25, 1900, **00,** 701.

RANCOCAS R., N. J. (See Schuylkill R., etc.)

RANCOCAS R., Bridgeboro, N. J. (S.) (Burlington County br.) PLANS.—Reconstr. approv. June 21, 1909, **09,** 918.

RANCOCAS R., Centerton, N. J. (S.) (Burlington County br.) PLANS.—Br. to replace existing str. approv. Sept. 3, 1903, **04,** 714.

RANCOCAS R., Delanco, N. J. (S.) (Pennsylvania R. R. Co.) PLANS.—Approv. July 28, 1904, **05,** 723.

RANCOCAS R., S. (Lumberton) Branch, Hainesport, N. J. (S.) (Burlington County br.) PLANS.—For reconstr. of br. approv. July 10, 1895, **95,** 479.

RANCOCAS R., Hainesport, Burlington County, N. J. (S.) (Burlington County br.) PLANS.—Rebuilding approv. Jan. 10, 1903, **03,** 647.

RANCOCAS R., Hainesport, N. J. (S.) (Pennsylvania R. R. Co.) PLANS.—Approv. Jan. 9, 1911, **11,** 1085.

RANCOCAS R., Washington Street, Mount Holly, N. J. (S.) (Burlington County br.) PLANS.—Approv. July 27, 1904, **05,** 723.

RANTOWLES CREEK, S. C. (O.) (Charleston and Colleton Counties br.) PLANS.—Completion of required alterations reports on Jan. 25, 1899, **99,** 625.

RANTOWLES CREEK, S. C. (O.) (Br. of Charleston and Colleton Counties.) PLANS.—Alterations to be completed within 4 months from May 18, 1909, **09,** 920.

RARITAN R., N. J., and tributaries. (Dr.) **06,** 797.

RARITAN R., Perth Amboy and South Amboy, N. J. (S. and O.) (Middlesex County br.) PLANS.—Approv. May 31, 1902; rebuilding approv. June 20, 1905, **05,** 728. Alterations to be completed Dec. 15, 1906, **06,** 809.

RARITAN R., Perth Amboy and South Amboy, N. J. (S.) (New York & Long Branch R. R. Co.) PLANS.—Approv. Oct. 19, 1905, **06,** 803.

RARITAN R., between South Amboy and Perth Amboy, N. J. (S.) (Jersey Central Traction Co.) PLANS.—Approv. Dec. 24, 1909, **10,** 1026.

RED BANK CREEK, near New Bethlehem, Pa. (S.) (Fairmount Coal Co.) PLANS.—Approv. Nov. 12, 1908, **09,** 916.

RED LAKE, East Grand Forks, Polk County, Minn. (S.) (Polk County br.) PLANS.—Approv. Apr. 18, 1902, **02,** 588.

RED LAKE R., Fisher, Polk County, Minn. (S.) (Polk County br.) PLANS.—Approv. Mar. 10, 1902, **02,** 587.

RED LAKE R., at Thief River Falls, Minn. (Sp.) (Minneapolis, St. Paul & Sault Ste. Marie Ry. Co.) Au. act Apr., 1904. PLANS.—Approv. Sept. 2, 1904, **05,** 720.

RED R., at or near Alexandria, La. (Sp.) (Shreveport & Red River Valley Ry. Co.) LEGISLATION.—Company au. to constr. br. by act Apr. 12, 1900. PLANS.—Approv. June 15, 1900, **00,** 698. Protection works approv Dec. 11, 1902, **03,** 643.

RED R., Upper Falls, near Alexandria, La. (Sp.) (Houston, Central Arkansas & Northern R. R. Co.) BE. constituted by S. O. No. 82, Dec. 1, 1890. (Maj. A. M. Miller, Capt. J. H. Willard, and Capt. H. S. Taber.) LEGISLATION.—Company au. to constr. br. by act Aug. 6, 1888; amending act Aug. 18, 1890. PLANS.—Amended plan, protests made against the location referred to a BE., and upon its recom. of Dec. 16, 1890, was approv. Dec. 29, 1890, **91,** 430.

RED R., near Alexandria, La. (S.) (Missouri Pacific Ry. Co.) PLANS.—Reconstr. plans approv. Dec. 14, 1910, **11,** 1085.

RED R., Alexandria to Pineville, La. (Sp.) (Alexandria & Pineville Br. Co.) Au. act June 6, 1900. PLANS.—Approv. Aug. 8, 1900, **01,** 659. Protection work for the draw span approv. Feb. 9, 1903, **03,** 644.

RED R., Grand Ecore, La. (O.) (Natchitoches Ry. & Constr. Co., and Natchitoches Parish.) PLANS.—Alterations to be completed on or before Apr. 30, 1904, subsequently waived for a reasonable period, **04,** 721.

RED R., Okla. and Tex., 7 m. e. of Denison, Tex. (Sp.) (William Kenefick.) Au. act Jan. 28, 1910. PLANS.—Approv. Mar. 25, 1910, **10,** 1021.

RED R., Shreveport, La. (A.) PLANS.—Formation of sand bar under draw of br. an obstr. to navigation. No action taken for its removal by br. au. **87,** 339, 2671.

RED R., Shreveport, La. (Sp.) (Shreveport Br. & Terminal Co.) Au. act Apr. 30, 1902. PLANS.—Approv. Nov. 19, 1902, **03,** 643. Modified plans, in lieu of these heretofore approv. were approv. Jan. 11, 1905, **05,** 720.

RED R., at Shreveport, La. (Sp.) (City br.) Au. act Feb. 3, 1905. PLANS.—As amended, approv. Jan. 17, 1910, **10,** 1020.

RED R., Texas Street, Shreveport, La. (Sp.) (City br.) Au. act Feb. 3, 1905. PLANS.—Approv. Jan. 17, 1910, and new plans for br. at Jones instead of Texas Street approv. Apr. 12, 1911, **11,** 1080.

RED R., near Texarkana, Ark. (Sp.) (Texarkana & Fort Smith R. R. Co.) LEGISLATION.—Company au. to constr. br. by act Jan. 20, 1897. PLANS.—Approv. Aug. 22, 1899, **99,** 620.

RED R., Turnbulls Isld., La. (Sp.) (Texas & Pacific Ry. Co.) Au. act Mar. 3, 1901. PLANS.—Approv. Sept. 4, 1901, **02,** 581, 582.

RED R. (Little), near Searcy, Ark. (S.) (White County br.) PLANS.—Approv. Sept. 16, 1910 **11,** 1083.

RED R. (Little), near Judsonia, Ark. (S.) (St. Louis, Iron Mountain & Southern Ry. Co.) PLANS.—Approv. Sept. 24, 1910, **11,** 1083.

RED RIVER OF THE NORTH, Drayton, N. Dak. (Sp.) (City br.) LEGISLATION.—City au. to constr. br. by acts Feb. 28, 1900, **00,** 697; Jan. 16, 1911. PLANS.—Approv. Apr. 18, 1900, **00,** 697. Approv. Mar. 28, 1911, **11,** 1080.

RED RIVER OF THE NORTH, N. Dak. (Dr.) **11,** 1078.

RED RIVER OF THE NORTH, Fargo, N. Dak. (Sp.) (Fargo & Moorhead Steel Ry. Co.) Au. act May 6, 1910. PLANS.—Approv. Apr. 26, 1911, **11,** 1081.

RED RIVER OF THE NORTH, Des Mers Avenue, Grand Forks, Dak. (Sp.) (City br.) LEGISLATION.—City au. to constr. br. by act May 21, 1888. PLANS.—Providing for trestlework approach on w. side of R., approv. Jan. 3, 1889; modification substituting filling for trestlework, approv. June 11, 1889, **89,** 370.

RED RIVER OF THE NORTH, Minnesota Avenue, Grand Forks, Dak. (Sp.) (City br.) LEGISLATION.—City au. to constr. br. by act May 21, 1888; amending act Mar. 1, 1889, **89,** 371. PLANS.—Approv. May 29, 1889, **89,** 371.

RED RIVER OF THE NORTH, Marshall County, Minn., and Walsh County, N. Dak. (Sp.) (Minneapolis, St. Paul & Sault Ste. Marie Ry. Co.) Au. act Jan. 24, 1905. PLANS.—Approv. Mar. 14, 1905, **05,** 721.

REDWOOD CREEK, Cal. (S.) (Redwood city br.) PLANS.—Approv. Feb. 11, 1910, **10,** 1027.

RICE CREEK, Fla. (S.) (Jacksonville, Tampa & Key West Ry. Co.) PLANS.—Reconstr. plans approv. July 22, 1899, **99,** 623.

RICES PT., chan. e. of, Duluth, Minn. (A.) PLANS.—P. built by the Eastern Minnesota Ry. Co. encroaching upon the chan., mayor of Duluth notified, but no action taken, **89,** 2798.

RIDLEY CREEK, near Chester, Pa. (See Schuylkill R.) (S.) (Baltimore & Ohio R. R. Co.) PLANS.—Reconstr. approv. Mar. 2, 1907, **07,** 825.

RIDLEY CREEK, Delaware County, Pa. (S.) (Chester & Philadelphia Ry. Co.) PLANS.—Approv. Aug. 10, 1910, **11,** 1082.

RIGOLETS, LA. (Dr.) **08,** 865.

RIO GRANDE R., Brownsville, Tex. (Sp.) (Brownsville & Gulf Ry. Co.) Au. acts May 20 and May 22, 1908. PLANS.—Approv. May 21, 1909, **09,** 913, 914.

RIO GRANDE R., between Laredo, Tex., and Nuevo Laredo, Mexico. (Sp.) (National Railways of Mexico.) Au. act Jan. 27, 1910. PLANS.—Approv. May 27, 1910, **10,** 1022.

ROANOKE R., near Weldon, N. C. (Sp.) (Northampton & Halifax Br. Co.) Au. act May 16, 1906. PLANS.—Approv. July 30, 1906, **07,** 816, 817.

ROCK CREEK, Massachusetts Avenue extended, Washington, D. C. (See Potomac R.) APPROPRIATION.—1897 (sur.), $2,000, **98,** 3624. ENGINEERS.—Chief of Engineers. **R., 98,** 541. Engineer in charge: Capt. D. D. Gaillard, 1898. **R., 98,** 3606. PROJECTS.—Capt. Gaillard est., 1897, $568,545 for the st. arch br., and $199,204 for the steel br., **98,** 3612, 3622. Description of proposed br., **98,** 3610, 3614, 3616. SURVEYS.—Plans and est. of cost of erecting a st. arch br., and also a steel br. with st. foundations, over Rock Creek on the line of Massachusetts Avenue extended, the full width of said avenue, au. by act Mar. 3, 1897; made, 1897, by Capt. D. D. Gaillard (see Projects), **98,** 3606.

ROCK CREEK, Pennsylvania Avenue, Washington, D. C. (See Potomac R.) (Br. No. 6, iron.) ENGINEERS.—Chief of Engineers. **R., 77,** 124. BE.[1] constituted by S. O. No. 8, dated Feb. 2, 1877, to ex. into the propriety of certain modifications of the Rock Creek Br., convened at Washington, Feb. 7, and at New

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[1] Q. M. Gen. M. C. Meigs (designer and builder of Rock Creek Br.) resents criticisms. Letters, **77,** ii, 1088.

York, Apr. 7, 1877. **R., 77,** ii, 1099. (Col. Z. B. Tower, Lt. Cols. H. G. Wright and Q. A. Gillmore.) Engineers in charge: Maj. N. Michler. 1867–70. Col. O. E. Babcock, 1873–77. **Rs., 73,** 1166; **74,** ii, 400; **75,** ii, 815; **76,** ii, 694; **77,** ii, 1095. Lt. Col. T. L. Casey, 1877–79. **Rs., 77,** ii, 1103; **78,** 1351; **79,** 1885. Col. G. H. Elliot. 1892–94. **Rs., 92,** 3361; **93,** 4290; **94,** 3203. Maj. J. G. D. Knight, 1895. **R., 95,** 4105. Capt. D. D. Gaillard, 1896–97. **Rs., 96,** 3914; **97,** 3999. Capt. T. A. Bingham, 1898. **R., 98,** 3630. Lt. Col. A. M. Miller, 1899–. **Rs., 99,** 3785; **00,** 5196. Assistant: T. B. Samo. **Rs., 67,** 550; **68,** 909; **69,** 506; **70,** 525. LEGISLATION.—Au. requested, 1873, by Col. Babcock to prevent further use of br. No. 6 over Rock Creek as a thoroughfare, except for use of pedestrians, and the cars of the Washington & Georgetown R. R., for such time to enable them to build a br. for their R. R., **73,** 1166. Act Mar. 3, 1875, provided for removal, within 1 year from Mar. 2, 1875, of the Washington & Georgetown R. R. from br. No. 6, **75,** ii, 815, 816. OPERATIONS.—**1867.** Br. No. 6 scraped and painted and some ornamental pieces, which had become detached, replaced, **67,** 550. **1867–68.** New sidewalk built and masonry abutments repaired, **68,** 909. **1869–75.** Br. painted and floor repaired, **69.** 506; **75,** ii, 815. **1878–80.** Br. repaired **78,** 1351; **79,** 1885; **80,** 2345. **1892–93.** Wooden superstr. renewed **93,** 4290. **1893–94.** Br. painted **94,** 3203. **1894–95.** Br. repaired, **95,** 4105. **1895–96.** New floor placed in br., **96,** 3914. **1898–99.** Br. painted **99,** 3785. **1899–00.** Floor renewed and br. painted **00,** 5196. PROJECTS.—Col. Babcock est. 1876, $70,000 to alter the Rock Creek Br. **76,** ii, 694; **77,** ii, 1098. Description of br. No. 6, **77,** ii, 1096, 1099. Col. Casey est., 1877, $75,000 to alter the road and footway over Rock Creek Br., **77,** ii, 1104. SURVEYS.—Maps. **77,** ii, 1100.

ROCK R., Moline, Ill. (O.) (City br.) ENGINEERS.—Chief of Engineers. **R., 96,** 428. PLANS.—Alterations required within 6 months from May 22, 1895. New hearing was granted, pending which the time of completion expired. New notice served requiring alteration to be made in one of the three methods described and be completed on or before Aug. 31, 1896. **96,** 428.

ROCK HOLE CREEK, Md. (See Traceys Creek.)

ROCKY R., Ohio. (S.) (New York, Chicago & St. Louis R. R. Co.) PLANS.—Rebuilding approv. May 16, 1906, **06,** 807.

ROCKYHOCK CREEK, Chowan County, N. C. (S.) (County br.) PLANS.—Approv. June 7, 1910, **10,** 1030.

RONDOUT CREEK, Kingston Station, N. Y. (S.) (West Shore R. R. Co. and New York Central & Hudson River R. R. Co.) PLANS.—Reconstr. approv. Jan. 30, 1902, **02,** 586.

ROOT R., Racine, Wis. (S.) (Chicago & North Western Ry. Co.) PLANS.—Br. to replace existing str. approv. Nov. 21, 1903, **04,** 715.

ROOT R., Herrick and Lafayette Avenues Racine, Wis. (S.) (City br.) PLANS.—Approv. May 28, 1907, **07,** 827.

ROOT R., Main Street, Racine, Wis. (S.) (City br.) PLANS.—Rebuilding approv. Feb. 16, 1906, **06,** 804.

ROUGE R., Delray, Mich. (S.) (Detroit & Lime Northern Ry. Co.) PLANS.—Modified plans approv. Nov. 26, 1897, **98,** 534.

ROUGE R., Delray, Mich. (S.) (Solvay Process Co.) PLANS.—Approv. June 28, 1902, **02,** 589.

ROUGE R., near Detroit, Mich. (S.) (Wabash R. R. Co.) PLANS.—For new br. submitted Nov. 3, 1892; approv. Feb. 16, 1893, on condition that the old br. and central p. be removed, **93,** 468.

ROUGE R., Dix Avenue, Mich. (O. and S.) (Ecorse and Springwells Townships' br. PLANS.—Br. to be removed or provided with a draw of 85′ on or before May 15, 1900, **00,** 702. Approv. Feb. 5, 1901, **01,** 664.

ROUGE R., Fort Street, Mich. (Ecorse and Springwells Townships' br.) PLANS.—For new br. approv. Jan. 5, 1900, **00,** 700.

ROUGE R., Oakwood, Mich. (S.) (Detroit, Monroe & Toledo Short Line Ry. Co.) PLANS.—Approv. Apr. 12, 1904, **04,** 717.

ROUGE R., River Road Crossing, Wayne County, Mich. (S.) (Ecorse and Springwells Townships' br.) PLANS.—Approv. Aug. 27, 1895, on condition that a chan. be dr. through one of the draw passages to communicate with the R. chan. above and below, **95,** 480.

RUNYANS CREEK, N. C. (S.) (Washington & Plymouth R. R. Co.) PLANS.—Approv. Aug. 22, 1901, **02,** 584.

S.

SABINE-NECHES CANAL, Port Arthur, Tex. (S.) (Port Arthur Pleasure Pier Co.) PLANS.—Reconstr. of existing temporary br. approv. Aug. 9, 1911, **12,** 1300.

SABINE R., La. and Tex. (Dr.) **08,** 865.

SACHEM BROOK, Quincy, Mass. (S.) (State br.) PLANS.—Approv. Oct. 18, 1905, **06,** 802.

SACRAMENTO R., Cal. (S.) (Br. of Mr. J. E. Terry.) PLANS.—Approv. Dec. 27, 1902, **03,** 647.

SACRAMENTO R., Balls Ferry, Shasta County, Cal. (S.) (County br.) PLANS.—Approv. Dec. 8, 1896, **97,** 533.

SACRAMENTO R., Butte City, Cal. (A.) PLANS.—Br., if built at the locality contemplated, would form a serious obstr. to navigation **88,** 2652.

SACRAMENTO R., Butte City, Cal. (S.) (Glenn County br.) PLANS.—Approv. Jan. 4, 1893; completion of br. reported on June 22, 1893. **93,** 467. Approv. Sept. 6, 1904, **05,** 724.

SACRAMENTO R., Chico Landing, Cal. (S.) (Northern Electric Ry. Co.) PLANS.—Approv. Apr. 29, 1907, **07,** 827. Permission for constr. of temporary br. granted June 24, 1911, **11,** 1090. Permission for reconstr. of temporary br. granted May 3, 1912, **12,** 1307.

SACRAMENTO R., Colusa, Cal. (S.) (Colusa County br.) PLANS.—Reconstr. plans approv. July 20, 1899, **99,** 623.

SACRAMENTO R., Grand Isld., Cal. (S.) (Sacramento County br.) PLANS.—Approv. Feb. 20, 1905, **05,** 726.

SACRAMENTO R., Hamilton and Chico, Cal. (S.) (Br. of Butte and Glenn Counties.) PLANS.—Approv. Feb. 26, 1908, **08,** 872.

SACRAMENTO R., Knights Landing, Cal. (S.) (Southern Pacific R. R. Co.) PLANS.—Rebuilding approv. Dec. 3, 1901, **02,** 586.

SACRAMENTO R., Meridian, Cal. (S.) (Northern Electric Ry. Co.) PLANS.—Approv. Mar. 19, 1912, **12,** 1306.

SACRAMENTO R., Sacramento, Cal. (S.) (California Pacific R. R. Co.) PLANS.—Reconstr. plans approv. June 11, 1895, **95,** 479.

SACRAMENTO R., at M Street, Sacramento, Cal., to town of Washington, Cal. (S.) (Northern Electric Ry. Co.) PLANS.—Approv. July 7, 1910, **11,** 1081.

SACRAMENTO R., Tehama, Cal. (O. and A.) (Southern Pacific Co. and Central Pacific R. R. Co.) PLANS.—Specified alterations to be completed on or before Dec. 31, 1898, **96,** 428. Plans approv. Feb. 23, 1898, **98,** 537. Rebuilding remainder of br. approv. May 22, 1901, **01,** 666. Alterations to be completed on or before Dec. 31, 1911, **10,** 1032.

SACRAMENTO R., C Street, Tehama, Cal. (S.) (County br.) PLANS.—Approv. Feb. 8, 1910, and modified plans approv. May 9, 1910, **10,** 1030.

SACRAMENTO R., between Washington, at D or Ann Streets, and the city of Sacramento, Cal. (S.) (Southern Pacific Co.) PLANS.—Reconstr. of an existing br. approv. Apr. 1, 1910, **10,** 1029.

SAG B. and SAG H. COVE, N. Y. (inlet connecting). (S.) (Suffolk County br.) PLANS.—Rebuilding approv. Aug. 29, 1900, **01,** 662.

SAGINAW R., near Bay City, Bay County, Mich. (S.) (Interurban Ry. Co.) PLANS.—Modified plan and map of new location approv. Jan. 15, 1896, **96,** 425.

SAGINAW R., Bay City, Mich. (S.) (Detroit & Mackinac Ry. Co.) PLANS.—Approv. Feb. 18, 1896, **96,** 426.

SAGINAW R., near Bay City, Mich. (S.) (Michigan Central R. R. Co.) PLANS.—Approv. Aug. 3, 1904, **05,** 723.

SAGINAW R., Bay City, Mich. (S.) (Bay City Terminal Ry. Co.—Grand Trunk Ry. system.) PLANS.—Approv. July 19, 1911, **12,** 1299. Modified plans approv. Jan. 13, 1912. Instrument dated July 19, 1911, revoked, **12,** 1304.

SAGINAW R., Bristol Street, Saginaw, Mich. (A.) (Central Br. Co.) **95,** 480. PLANS.—Br. damaged by cyclone in Sept., 1894, and repaired without lawful au.; complaint made that br. was an obstr. to navigation; permission given company to allow the constr.; approv. Nov. 16, 1894, to remain temporarily on condition that all obstrs. be removed by the opening of spring navigation, and the br. be reconstr. by that time, **95,** 480.

SAGINAW R., Court Street, Saginaw, Mich. (S.) (City br.) PLANS.—Approv. Mar. 2, 1898, **98,** 534.

SAGINAW R., Saginaw, Mich. (S.) (City br.) PLANS.—Approv. Sept. 4, 1903, in lieu of approv. given June 9, 1902, to plans previously presented, **04,** 714.

SAGINAW R., Center Street, Saginaw, Mich. (S.) (City br.) PLANS.—Approv. Aug. 23, 1904, **05,** 723.

SAGINAW R., Genessee Avenue, Saginaw, Mich. (S.) (City br.) PLANS.—Rebuilding approv. June 9, 1902, **02,** 589.

SAGINAW R., 6th Street, Saginaw, Mich. (S.) (City br.) PLANS.—Approv. Aug. 23, 1904, **05,** 723.

ST. AUGUSTINE CREEK. (See Ashley R.)

ST. AUGUSTINE CREEK, Ga. (Dr.) **06,** 797.

ST. AUGUSTINE CREEK, on line of Savannah & Tybee R. R., Ga. (O.) (Central of Georgia Ry. Co.) PLANS.—Alterations to be completed within 3 months from Oct. 23, 1902, **03,** 652.

ST. CHARLES R., between Boston and Cambridge, at Cottage Farm, Mass. (S.) (New York Central & Hudson River R. R. Co., lessee of Boston & Albany R. R.) PLANS.—Reconstr. plans approv. Jan. 30, 1911, **11,** 1086.

ST. CLAIR LAKE, Northwest Corner, Mich. (S.) (Rapid R. R. Co.) PLANS.—Embankment, trestle, and drawbr. approv. Jan. 25, 1898, **98,** 534.

ST. CROIX R., between Burnett County, Wis., and Pine County, Minn. (Sp.) (Minneapolis, St. Paul & Sault Ste. Marie Ry. Co.) Au. act Aug. 10, 1911. PLANS.—Approv. Sept. 14, 1911, **12,** 1296.

ST. CROIX R., Hudson, Wis. (Sp.) (Br. of H. L. North, W. E. Webster, and H. J. Anderson.) Au. act Feb. 18, 1911. PLANS.—Approv. Aug. 17, 1911, **12,** 1295.

ST. CROIX R., Wis. and Minn. (Dr.) **09,** 912.

ST. CROIX R., Stillwater, Minn. (S.) COMMERCE.—Br. would not materially obstr. navigation, **76,** ii, 315. ENGINEERS.—Chief of Engineers. **Rs., 76,** i, 92. Approv. recom. of Maj. Farquhar, **76,** ii, 313. LEGISLATION.—Br. au. by Minnesota, **76,** ii, 315. PLANS.—Description of br., **76,** ii, 315. Maj. Farquhar recom. br. be raised 2′. **R., 76,** ii, 315. Approv. by Sec. of War, **76,** ii, 314.

ST. CROIX R., Wis. and Minn. (Sp.) (Chippewa Falls & Western Ry. Co.) LEGISLATION.—Au. by act Apr. 28, 1884, **84,** 270. PLANS.—Approv. May 8, 1884, **84,** 271.

ST. CROIX R., Wis. and Minn. (from e. bank in St. Croix County, Wis., to w. bank in Washington County, Minn.). (Sp.) (Wisconsin Central Ry. Co.) Au. act Mar. 12, 1911; reenacted Aug. 17, 1911. PLANS.—Approv. Sept. 9, 1911, **12,** 1296.

ST. CROIX R., Osceola, Wis. (Sp.) (Village br.) LEGISLATION.—Village au. to constr. br. by act Aug. 27, 1894. PLANS.—Approv. Sept. 23, 1895, **96,** 422.

ST. CROIX R., between Taylors Falls, Minn., and St. Croix Falls, Wis. (Sp.) (Village br.) Au. act Mar. 26, 1910. PLANS.—Reconstr. approv. May 27, 1910, and modification of permit approv. June 21, 1910, **10,** 1023.

ST. FRANCIS LAKE, near Lake City, Ark. (Sp.) (Jonesboro, Lake City & Eastern R. R. Co.) LEGISLATION.—Company au. to constr. br. by act June 16, 1898. PLANS.—Approv. Aug. 8, 1898, **98,** 532.

ST. FRANCIS LAKE, at or near Lake City, Ark. (Sp.) (St. Francis Br. & Turnpike Co.) LEGISLATION.—Company au. to constr. br. by act Mar. 6, 1896. PLANS.—Approv. Aug. 24, 1897, **97,** 531.

ST. FRANCIS R. (See Petit Jean R.)

ST. FRANCIS R., Ark. (O.) (St. Louis, Arkansas & Texas R. R. Co.) PLANS.—Alterations required by Sept. 1, 1889, **89,** 377. Notice served as to alterations required, **90,** 342.

ST. FRANCIS R., Ark. (Dr.) **07,** 815.

ST. FRANCIS R., Ark. (Sp.) (St. Louis, Iron Mountain & Southern Ry. Co.) Au. act Aug. 15, 1911. PLANS.—Approv. Sept. 1, 1911, **12,** 1296.

ST. FRANCIS R., where secs. 21 and 28, T. 19 N., R. 9 E., Clay County, Ark., touches said R. (Sp.) (Campbell Lumber Co.) Au. act Feb. 23, 1906. PLANS.—Approv. May 31, 1906, **06,** 800.

ST. FRANCIS R., Fisk, Mo. (Sp.) (Br. of Butler and Stoddard Counties.) Au. act May 6, 1910. PLANS.—Approv. Apr. 24, 1911, **11,** 1081.

ST. FRANCIS R., below Kennett, Mo. (A.) (Paragould Southeastern R. R. Co.) PLANS.—Br., constr. without au., being an unreasonable obstr., the Atty. Gen. instituted proceedings, under sec. 10, act Sept. 19, 1890, against the company; plans providing for a draw in the br. approv. Mar. 26, 1895, **95,** 481.

ST. FRANCIS R., in Lee County, Ark. (Sp.) (Memphis, Helena & Louisiana Ry. Co.) Au. act Feb. 18, 1903. PLANS.—Approv. Apr. 20, 1903, **03,** 644.

ST. FRANCIS R., Madison, Ark. (Sp.) (St. Francis County br.) Au. act Jan. 16, 1908. PLANS.—Approv. Mar. 10, 1908, **08,** 867.

ST. FRANCIS R., at Marked Tree, Ark. (Sp.) (Poinsett County br.) Au. act Feb. 2, 1904. PLANS.—Approv. July 6, 1905, **06,** 798.

ST. FRANCIS R., near Parkin, Ark. (Sp.) (St. Louis, Iron Mountain & Southern Ry. Co.) Au. act Feb. 19, 1910. PLANS.—Reconstr. approv. Mar. 15, 1910, **10,** 1021.

ST. FRANCIS R., at or near St. Francis, Ark. (Sp.) (A. R. Vanmatre.) Au. act Mar. 3, 1903. PLANS.—Approv. Mar. 26, 1903, **03,** 644.

ST. JOHNS R., at Cooks Ferry, near outlet of Lake Harney, Fla. (Florida East Coast Ry. Co.) PLANS.—Approv. Jan. 11, 1911, **11,** 1085.

ST. JOHNS R., Buffalo Bluff, Fla. (Sp., etc.) (Jacksonville, Tampa & Key West Ry. Co.) LEGISLATION.—Company au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Florida. PLANS.—New br. approv. July 20, 1892, **92,** 407.

ST. JOHNS R., foot of Lake Monroe, Fla. (S.) (Jacksonville, Tampa & Key West Ry. Co.) PLANS.—Reconstr. plans approv. June 1, 1893, **93,** 469.

ST. JOHNS R., Fla. (Dr.) **03,** 642; **11,** 1078.

ST. JOHNS R., Geneva Ferry, Orange County, Fla. (S.) (Orange County brs.) PLANS.—Approv. Dec. 21, 1911, **12,** 1303.

ST. JOHNS R., Palatka, Fla. (S.) (Jacksonville, St. Augustine & Indian River Ry. Co.) PLANS.—Reconstr. of br. submitted Sept. 1, 1894; modified Sept. 20, 1894; approv. Oct. 9, 1894, **95,** 477.

ST. JOHNS R., Palatka, Fla. (S.) (Putnam County br.) PLANS.—Approv. Feb. 6, 1909, **09,** 917.

ST. JONES R. (See Christiana R. and—.)

ST. JOSEPH H., St. Joseph, Mich. (A.) (Ry.) COMMERCE.—Br. a serious obstr. to navigation, **76,** ii, 317. ENGINEERS.—BE. convened at St. Joseph, Mich., June 10, 1875. Recom. modifications of br., **76,** ii, 317. (Majs. Houston, Gillespie, and Mansfield.) PLANS.—Description of br., **76,** ii, 316.

ST. JOSEPH R., near mouth, Mich. (A. and O.) (Chicago & West Michigan Ry. Co.) **89,** 375; **90,** 340; **92,** 411; **93,** 471. LEGISLATION.—Sec. of War approv., May 17, 1889, recom. that the alterations being made in the draw be put to trial, **89,** 375, 2801. PLANS.—On Dec. 4, 1888, alterations were ordered, and a draw with 2 openings of 100′ each constr. Removal of obstrs. in draw, required by Apr. 30, 1889, **89,** 375, 2801; **90,** 340. Removal of obstrs. to 15′ on or before May 15, 1892, and also constr. of an addl. draw on or before Nov. 1, 1892, **92,** 411. On company's protest, after removal of obstr., Sec. of War deferred constr. of n. draw; alterations made in 1888 and 1891, approv. Feb. 9, 1893, **93,** 471.

ST. JOSEPH R., near St. Joseph, Mich. (A.) (Ry.) PLANS.—Description of br., **88,** 2585. Capt. Lockwood proposed to replace the existing s. draw with a pivot draw having clear openings of 100′, **88,** 2586.

ST. JOSEPH R., St. Joseph to Benton H., Mich. (A.) PLANS.—3 wooden brs., more or less an obstr. to navigation, **89,** 2801, 2802.

ST. JOSEPH R., Mich. (S.) (St. Joseph Valley Ry. Co.) PLANS.—Approv. Mar. 11, 1897, **97,** 533.

ST. JOSEPH R., St. Joseph, Mich. (Sp.) (Indiana, Illinois & Iowa R. R. Co.) Au. act Feb. 18, 1901. PLANS.—Approv. Feb. 27, 1901, **01,** 660.

ST. JOSEPH R., near its mouth, Berrien County, Mich. (Sp.) (Berrien County br.) Au. act Mar. 2, 1905. PLANS.—Approv. Mar. 23, 1905, **05,** 721.

ST. JOSEPH R., State Street, St. Joseph, Mich. (Sp.) (City br.) Au. act Mar. 6, 1908. PLANS.—Approv. Mar. 20, 1908, **08,** 867.

ST. JOSEPH R., Wayne Street, St. Joseph, Mich. (S.) (City br.) PLANS.—Reconstr. approv. Mar. 24, 1908, **08,** 872.

ST. LAWRENCE R., near Hogansburg, N. Y. (Sp.) (Northern New York R. R. Co.) LEGISLATION.—Company au. to constr. br. by act Mar. 2, 1897. PLANS.—Approv. Aug. 21, 1897, **97,** 531.

ST. LAWRENCE R., Morristown, N. Y. (Sp.) (St. Lawrence Ry. Co.) LEGISLATION.—Company au. to constr. br. by act Feb. 9, 1893, **94,** 425. PLANS.—Approv. Feb. 6, 1894, **94,** 425. Modified plans approv. Aug. 29, 1895, **95,** 476.

ST. LOUIS R., between Rices Pt. and Connors Pt., Duluth H., Minn. (S.) (Great Northern Ry. Co.—Interstate br.) PLANS.—Reconstr. approv. Apr. 1, 1907, **07,** 826.

ST. LOUIS R., between Duluth, Minn., and Superior, Wis. (S.) (Northern Pacific Ry. Co.) PLANS.—Reconstr. approv. Jan. 22, 1907, **07,** 824.

ST. LOUIS R., Connors Pt., Wis., to Rices Pt., Minn. (Sp.) (Duluth & Superior Br. Co.) LEGISLATION.—Company au. to constr. br. by act Apr. 24, 1894; amending act Aug. 4, 1894, **95,** 475. PLANS.—Temporary br. approv. Dec. 15, 1894, **95,** 477. Approv. Apr. 10, 1895, **95,** 475.

ST. LOUIS R., Duluth, Minn., to Superior, Wis. (S.) (Superior Rapid Transit Ry. Co., and the Duluth Street Ry. Co.) PLANS.—Temporary pile and trestle br. approv. Nov. 23, 1895, **96,** 425. Temporary pile and trestle br. approv. Nov. 20, 1896, **97,** 533.

ST. LOUIS R., between Duluth, Minn., and Superior, Wis. (Sp.) (Northern Pacific Ry. Co.—Grassy Pt. br.) Au. act Jan. 3, 1887. PLANS.—Br. to replace existing str. approv. May 10, 1909, **09,** 913.

ST. LOUIS R., near Duluth, Minn., and Superior, Wis. (Sp.) (Interstate Transfer Ry. Co.) Au. act Feb. 20, 1908. PLANS.—Approv. Mar. 16, 1908, **08,** 867.

ST. LOUIS R., about 12 m. above Superior, Wis. and Minn. (Sp., etc.) (Superior Belt Line & Terminal Ry. Co.) LEGISLATION.—Company au. to constr. br. by act Feb. 24, 1891, **92,** 403. PLANS.—Duluth, Red Wing & Southern R. R. Co. relinquished its right, granted by act Feb. 24, 1891, to the other beneficiary of the act whose modified plans were approv. Dec. 26, 1891, **92,** 406.

ST. LOUIS R., from Grassy Pt., Minn. (O.) (St. Paul & Duluth Ry. Co.) PLANS.—Alterations required by Sept. 1, 1889, **89,** 376. Notice served as to required alteration; Atty. Gen. notified that the alterations were not made in the required time, **90,** 342.

ST. LOUIS R., at Rices Pt., Minn., and Connors Pt., Wis. (S.) (Northern Pacific Ry. Co.) PLANS.—Reconstr. approv. Mar. 24, 1906, **06,** 805.

ST. LOUIS R., Minn. and Wis. (Sp.) (Northern Pacific R. R. Co.) ENGINEERS.—BE. convened to consider and R. upon plan and location of br., **85,** 1928. Board recom. approv. of plans with following modifications: Omission of open span between the draw span and Rices Pt., and that the company shall constr., whenever required, a draw near the Wisconsin shore. **85,** 1930. (Lt. Col. Poe, Majs. Mackenzie and

Allen.) LEGISLATION.—Br. au. by act Feb. 27, 1873, **85**, 293. Requirements of act, **85**, 1927. PLANS.—Reason for change in location proposed by R. R. company, **85**, 1925, 1927. Plan described as proposed by R. R. company, **85**, 1929. Modifications recom. by BE., **85**, 1930. Draw on Wisconsin side subsequently provided for, **85**, 1935.

ST. LOUIS R., Wis. (Sp.) (Wisconsin & New Duluth Br. Co.) LEGISLATION.—Company au. to constr. br. by act Mar. 2, 1895. PLANS.—Modified plans approv. Feb. 27, 1896, **96**, 423.

ST. LUCIE R., Fla. (Dr.) **03**, 642.

ST. LUCIE R., Fla. (S.) (Jacksonville, St. Augustine & Indian River Ry. Co.) PLANS.—Approv. Aug. 15, 1893, **93**, 471.

ST. LUCIE R., Kitchens and Fosters Pts., Fla. (S.) (Florida East Coast Ry. Co.) PLANS.—Reconstr. approv. May 13, 1905, **05**, 727.

ST. MARKS R. and **LITTLE ST. MARKS R.**, Fla. (S.) (Apalachicola Northern R. R. Co.) PLANS.—Approv. Dec. 29, 1905, **06**, 803.

ST. MARTINS R., near Bishopville, Md. (O.) (Worcester County br.) PLANS.—Alterations to be completed on or before June 30, 1910, **10**, 1032.

ST. MARYS FALLS CANAL. (See St. Marys R.)

ST. MARYS R., Ga. and Fla. (Sp.) (Florida Central & Peninsular R. R. Co.) LEGISLATION.—Constr. au. Feb. 14, 1893, **93**, 464. PLANS.—Approv. Mar. 28, 1893, **93**, 464.

ST. MARYS R., near Folkston, Ga. (Sp.) (Atlantic Coast Line R. R. Co.) Au. act Dec. 23, 1880. PLANS.—Br. to replace existing str. approv. Mar. 2, 1908, **08**, 867.

ST. MARYS R. and **ST. MARYS FALLS CANAL**, at the rapids of the St. Marys R., Mich. (Sp.) (Sault Ste. Marie Br. Co.) **88**, 308; **91**, 3869. LEGISLATION.—Constr. au. by act July 8, 1882, **88**, 2461; **91**, 3869. PLANS.—Lt. Col. Poe approv. location of br. as proposed, **88**, 2458.

SAKONNET or **SEACONNET R.**, Tiverton, R. I. (O.) (Old Colony R. R. Co.) PLANS.—Specified alterations required on or before July 1, 1894. On July 1, 1894, further specified alterations required. **93**, 474.

SAKONNET R., R. I. (Dr.) **02**, 581; **11**, 1078.

SAKONNET R., R. I. (See Sakonnet R.—p. 120 of this Index.) (Stone br.)

SAKONNET R., Tiverton, R. I. (A. and O.) (New York, New Haven & Hartford R. R. Co.) **98**, 538; **99**, 624. PLANS.—Specified alterations to be completed on or before May 1, 1899, **98**, 538. Proceedings were instituted against company; plans in accordance with specified requirements approv. Jan. 16, 1899, **99**, 624.

SAKONNET R., Tiverton and Portsmouth, R. I. (S.) (State br.—st. br.) PLANS.—Reconstr. approv. Feb. 28, 1905, **05**, 726.

SALEM CREEK, Course Landing, N. J. (O.) (Salem County br.) PLANS.—Alterations to be completed on or before July 1, 1908, **07**, 829.

SALEM R. (See Schuylkill R.)

SALINE R. (See Petit Jean R.)

SALINE R., Ashley and Bradley Counties, Ark. (S.) (Little Rock & Southern Ry. Co.) PLANS.—Approv. Oct. 5, 1905, **06**, 802.

SALKAHATCHIE R. (See Ashley R.)

SALMON B. WATERWAY, w. of the U. S. Canal Reservation, in the vicinity of 34th Avenue NW., Seattle, Wash. (S.) (Washington R. R. Co.) PLANS.—Approv. Jan. 17, 1910, **10**, 1026.

SALMON B. WATERWAY, w. of the U. S. Canal Reservation, in the vicinity of 34th Avenue NW., Seattle, Wash. (S.) (Great Northern Ry. Co.) PLANS.—Approv. Jan. 17, 1910, **10**, 1026.

SALMON R., East Haddon, Conn. (S.) (Moodus & East Hampton Ry. Co.) PLANS.—Approv. Aug. 20, 1900, **01**, 662.

SALMONS ISLD. THOROFARE, N. J. (S.) (Long Beach Turnpike Co.) PLANS.—Approv. Mar. 14, 1912, **12**, 1306.

SALT R., Shepherdsville, Ky. (S.) (Bullitt County br.) PLANS.—Approv. Aug. 29, 1905, **06**, 801.

SALT R., Shepherdsville, Ky. (S.) (Louisville & Nashville R. R. Co.) PLANS.—Reconstr. approv. June 30, 1909, **09**, 919.

SALT R., near West Point, Ky. (S.) (Louisville, St. Louis & Texas Ry. Co.) PLANS.—Modified plans approv. May 15, 1893, **93**, 469.

SALT R., West Point, Ky. (S.) (Illinois Central R. R. Co.) PLANS.—Reconstr. approv. Apr. 27, 1909, **09**, 918.

SALT R., West Point, Ky. (S.) (Br. of Hardin and Jefferson Counties.) PLANS.—Approv. July 19, 1911, **12**, 1299.

SAMMAMISH R. (Squak Slough) below Bothel, Wash. (O.) (King County br.) PLANS.—Alterations to be completed on or before Oct. 1, 1909, **09**, 919.

SANALICUM CREEK. (See Whatcum Creek.)

SAN BERNARDO R., Tex. (S.) (St. Louis, Brownsville & Mexico Ry. Co.) PLANS.—Approv. Oct. 6, 1905, **06**, 802.

SAN BERNARD R., Churchills Ferry, Tex. (S.) (Brasoria County br.) PLANS.—Approv. Nov. 7, 1893; reported completed, **94**, 426.

SAN BERNARDO R., Hinkle Ferry, Tex. (S.) (Brazoria County br.) PLANS.—Approv. Aug. 14, 1911, **12**, 1300.

SANDUSKY B., Ohio. (Sp., etc.) (Lake Shore & Michigan Southern Ry. Co.) LEGISLATION.—Company au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Ohio, **92**, 403. PLANS.—Orig. plans approv. Jan. 16, 1892, **92**, 403. Modified plans approv. Nov. 23, 1892, **93**, 466.

SAN FRANCISCO, CAL., Channel Street waterway at 3d and Kentucky Streets. (S.) (City br.) PLANS.—Approv. Nov. 23, 1903, **04,** 715.

SAN FRANCISCO B., Dumbarton or Potrero Pt., Cal. (S.) (Southern Pacific Co.) PLANS.—Approv. Nov. 14, 1906, **07,** 823.

SAN FRANCISCO B., Dumbarton Pt., Cal. (S.) (Southern Pacific Co.) PLANS.—Approv. Nov. 24, 1906; modified plans approv. June 2, 1909, **09,** 916.

SAN GABRIEL (Los Angeles) **R.,** Long Beach, Cal. (O.) (San Pedro, Los Angeles & Salt Lake R. R. Co.) PLANS.—Alterations to be completed on or before 9 months from Dec. 11, 1906, **07,** 829.

SAN JACINTO R., Tex. (S.) (Houston, Beaumont & New Orleans R. R. Co.) PLANS.—Approv. Feb. 4, 1903, **03,** 648.

SAN JACINTO R., near Stafford, Tex. (S.) (Harris County br.) PLANS.—Approv. Apr. 25, 1908, **08,** 872.

SAN JOAQUIN R., Cal. (S.) (Alameda & San Joaquin R. R. Co.) PLANS.—Approv. Sept. 23, 1895, **96,** 424.

SAN JOAQUIN R., Cal. (S.) (Central Pacific R. R. Co.) PLANS.—Reconstr. of br. submitted Apr. 19, 1895; modified May 7, 1895; approv. May 21, 1895, **95,** 478.

SAN JOAQUIN R., Brandts Ferry, Cal. (S.) (San Joaquin County br.) PLANS.—Approv. July 18, 1900, **01,** 661.

SAN JOAQUIN R. (Burns Cut-off), Cal. (S.) (San Joaquin County br.) PLANS.—Approv. Jan. 2, 1901, **01,** 664.

SAN JOAQUIN R., near Dospalos, Cal. (S.) (Merced County br.) PLANS.—Approv. June 7, 1904, **04,** 719.

SAN JOAQUIN R., Durhams Ferry, Cal. (S.) (County br.) PLANS.—Approv. Jan. 2, 1901, **01,** 664.

SAN JOAQUIN R., Garwood Ferry Crossing, Cal. (S.) (San Joaquin County br.) PLANS.—Approv. Jan. 3, 1893, **93,** 467.

SAN JOAQUIN R., near Grayson, Cal. (S.) (Stanislaus County br.) PLANS.—Approv. Sept. 29, 1892; completion of br. reported on June 10, 1893, **93,** 466.

SAN JOAQUIN R., Hills Ferry, Cal. (S.) (Stanislaus and Merced Counties' br.) PLANS.—Approv. July 27, 1899, **99,** 623. New plans approv. May 27, 1901, **01,** 666.

SAN JOAQUIN R., at Roberts and Rough and Ready Islds., Cal. (S.) (San Joaquin County br.) PLANS.—Approv. Feb. 23, 1906, **06,** 804.

SAN JOAQUIN R., near Stockton, Cal. (S.) (San Francisco & San Joaquin Valley R. R. Co.) PLANS.—Approv. Sept. 1, 1898, **99,** 620.

SAN JUAN H., Porto Rico. (Sp.) (Behn Bros.) Au. act Feb. 25, 1909. PLANS.—Approv. Apr. 29, 1909; modified plans approv. Oct. 21, 1909, **10,** 1020.

SAN LEANDRO B., Alameda, Cal. (S.) (Southern Pacific Co.) PLANS.—Rebuilding approv. Aug. 7, 1903, **04,** 713.

SAN LEANDRO B., chan. connecting with San Francisco B. between Alameda and Bay Farm Isld., Alameda County, Cal. (S.) (Alameda County br.) PLANS.—Br. to replace existing str. approv. Sept. 22, 1902, **03,** 646.

SAN RAFAEL CREEK, Marin County, Cal. (S.) (Bay Counties Ry. Co.) PLANS.—Approv. July 14, 1906, **07,** 820.

SAN SEBASTIAN R., St. Augustine, Fla. (S.) (Florida East Coast Ry. Co.) PLANS.—Approv. Sept. 3, 1904, **05,** 723, 724.

SANTEE R., S. C. (A.) (Northeastern R. R. Co.) PLANS.—Capt. Bixby recom. draw-span openings of the br. be provided with suitable fenders, **88,** 2548.

SANTEE R., about 17 m. below mouth of Congaree R., Ga. (S.) (Manchester & Augusta R. R. Co.) PLANS.—Approv. June 20, 1893, **93,** 470.

SANTEE R., near Ferguson, S. C. (Sp.) (Santee River Cypress Lumber Co.) Au. act Feb. 6, 1909. PLANS.—Approv. Apr. 14, 1909, **09,** 913.

SANTEE R., at St. Stephens and Gourdin, S. C. (O.) (Atlantic Coast Line R. R. Co.) PLANS.—Alterations to be completed on or before 3 months from Sept. 1, 1909, **10,** 1031.

SATILLA R., Ga. (See Ogeechee R.)

SAUGATUCK R., Westport, Conn. (S.) (New York, New Haven & Hartford R. R. Co.) PLANS.—Rebuilding approv. Apr. 2, 1904, **04,** 717.

SAUGUS R., Mass. (S.) (Metropolitan Park Commission of Mass.) PLANS.—Approv. Mar. 16, 1899, **99,** 622.

SAUGUS R., between Revere and Lynn, Mass. (S.) (Metropolitan Park Commission.) PLANS.—Modified plans approv. May 6, 1903, **03,** 650.

SAUGUS R., between Revere and Lynn, Mass. (S.) (State br.) PLANS.—Approv. Feb. 13, 1904, to be in lieu of plans approv. May 6, 1903, **04,** 716.

SAUGUS R., Lynn, Mass. (S.) (Boston & Maine R. R. Co.) PLANS.—Reconstr. of existing br., including temporary pile br. alongside existing br., approv. Feb. 23, 1911, **11,** 1087.

SAUGUS R., between Saugus and Lynn, Mass. (S.) (Lynn & Boston R. R. Co.) PLANS.—Reconstr. approv. Mar. 14, 1899, **99,** 622.

SAUGUS R., between Lynn and Saugus, Mass. (S.) (Essex County br.) PLANS.—Reconstr. of existing br., including temporary br. without draw, approv. Jan. 11, 1912, **12,** 1304.

SAVANNAH R. (See Ashley R.)

SAVANNAH R., Augusta, Ga. (O.) (Southern Ry. Co.) PLANS.—Alterations to be completed on or before Jan. 1, 1905; subsequently extended to Jan. 1, 1906, **04,** 720.

SAVANNAH R., Augusta, Ga. (O.) (City br.) PLANS.—Alterations to be completed on or before Jan. 1, 1905; subsequently extended to Jan. 1, 1906, **04**, 720.

SAVANNAH R., at 5th Street, Augusta, Ga. (S.) (City br.) PLANS.—Replacing a former br. approv. July 14, 1909, **10**, 1023.

SAVANNAH R., near Augusta, Ga. (A. and O.) (Charleston & Western Carolina Ry. Co.) PLANS.—Conforming to specified requirements approv. June 10, 1899, **99**, 624. Specified alterations required on or before Nov. 1, 1899, **99**, 625.

SAVANNAH R., below Augusta, Ga. (O.) (Port Royal & Augusta Ry. Co.) PLANS.—Specified alterations required on or before Nov. 1, 1891, **91**, 435.

SAVANNAH R., near Augusta, Ga. (S.) (Port Royal & Augusta Ry. Co.) PLANS.—Erection of certain strs. for protection of this br. and for training the chan. through the draw span approv. June 20, 1894, **94**, 429.

SAVANNAH R., below Augusta, Ga. (O.) (Charleston & Western Carolina Ry. Co.) PLANS.—Alterations to be completed on or before Sept. 1, 1902, for alteration "1," and on or before Jan. 1, 1903, for alteration "2," **02**, 591.

SAVANNAH R., between Hutchinson Isld. and the mainland, Ga. (Sp.) (Georgia & Alabama Ry. Co.) LEGISLATION.—Company au. to constr. br. by act Feb. 2, 1899. PLANS.—Approv. Mar. 11, 1899, **99**, 619.

SAVANNAH R., at Hutchinson Isld., Savannah, Ga. (O. and Sp.) (Seaboard Air Line Ry. Co.) PLANS.—Alterations to be completed within 18 months from Feb. 21, 1907. Time subsequently extended to July 1, 1909. **07**, 829. Reconstr. approv. Nov. 12, 1908, **09**, 912.

SAVANNAH R., Savannah, Ga. (Sp.) (Atlantic Coast Line R. R. Co.) PLANS.—Reconstr. approv. May 21, 1909, **09**, 914.

SAVANNAH R., near Sisters Ferry, Effingham County, Ga. (Sp.) (South Bound R. R. Co.) LEGISLATION.—Company au. to constr. br. by act Aug. 7, 1890, **91**, 429. PLANS.—Approv. Nov. 4, 1890, **91**, 429.

SAWYER CREEK, Oshkosh, Wis. (S.) (City br.) PLANS.—Reconstr. plans approv. Jan. 17, 1899, **99**, 621.

SCHUYLKILL R., at Filbert Street, Philadelphia, Pa. (S.) (Br. (B) of Pennsylvania R. R. Co.) PLANS.—Widening br. (B) approv. Mar. 25, 1910, **10**, 1028.

SCHUYLKILL R., Grays Ferry, Philadelphia, Pa. (S.) (Philadelphia, Wilmington & Baltimore R. R. Co.) PLANS.—Rebuilding approv. Feb. 8, 1901, **01**, 665.

SCHUYLKILL R., Norristown and Bridgeport, Pa. (S.) (Philadelphia & Western Ry. Co.) PLANS.—Approv. Apr. 8, 1911, **11**, 1088.

SCHUYLKILL R., Pa. (Dr.) **02**, 581.

SCHUYLKILL R., Philadelphia, Pa. (S.) (City br.) PLANS.—Approv. Apr. 17, 1897, **97**, 534.

SCHUYLKILL R., Philadelphia, Pa. (Sp. and A.) COMMERCE.—Large and increasing. Br. a serious obstr. to navigation, H. Doc. 62, 43d Cong., 1st sess. LEGISLATION.—Br. au. by Congress, H. Doc. 62, 43d Cong., 1st sess.

SCHUYLKILL R., Market Street, Philadelphia, Pa. (S.) (Market Street Elevated Passenger Ry. Co.) PLANS.—Approv. Jan. 30, 1903, **03**, 648.

SCHUYLKILL R., Passyunk Avenue, Philadelphia, Pa. (S.) (City br.) PLANS.—Approv. Dec. 21, 1901, **02**, 586. Modified plans in lieu thereof approv. Feb. 11, 1908, **08**, 871.

SCHUYLKILL R., Philadelphia, Pa. (S.) (Pennsylvania R. R. Co.) PLANS.—Reconstr. of fenders of existing br. approv. Apr. 10, 1912, **12**, 1307.

SCHUYLKILL R., at Philadelphia, Pa.; **RANCOCAS R.**, N. J.; **RACCOON CREEK**, N. J.; **SALEM CREEK**, N. J.; **THE NORTH BRANCH OF THE SUSQUEHANNA**, Pa.; **THE THOROUGHFARE BETWEEN CAPE MAY AND GREAT BAY AT ATLANTIC CITY**, N. J.; and **ACROSS FRANKFORD, PENSAUKEN, WOODBURY, MANTUA, DARBY, RIDLEY**, and **CHESTER CREEKS**, N. J. PLANS.—Description, **88**, 2612.

SCHUYLKILL R., at Swedeland and Ivy Rock, Pa. (S.) (Upper Merion & Plymouth R. R. Co.) PLANS.—Approv. Apr. 7, 1910, and modified plans approv. May 27, 1910, **10**, 1029.

SCOTCH BONNET THOROFARE, N. J. (See Great Chan.)

SCOTTS CREEK, at Hospital and Pinner Pts., Va. (S.) (Atlantic Coast Line R. R. Co.) PLANS.—Reconstr. approv. July 6, 1908, **09**, 914.

SCOTTS CREEK, Norfolk County, Va. (S.) (Norfolk & Carolina R. R. Co.) PLANS.—Approv. Jan. 9, 1895. Br. completed. **95**, 477.

SCUPPERNONG R., near Columbia, N. C. (S.) (Virginia & Carolina Coast R. R. Co.) PLANS.—Approv. Apr. 20, 1906, **06**, 806.

SCUPPERNONG R., Tyrrell County, N. C. (O.) (County brs.) PLANS.—Required a 40′ draw in each br. to be completed without delay after the money to pay the expenses thereof should be deposited with the county commissioners, **99**, 625.

SEATTLE (canal waterway), Wash. (S.) (Seattle-Tacoma Ry. Co.) PLANS.—Approv. Aug. 12, 1901, **02**, 584.

SEATTLE H., e. and w. waterways, Wash. (S.) (Seattle Electric Co.) PLANS.—Approv. Aug. 15, 1908, **09**, 914.

SEBASTIAN R., Fla. (Dr.) **03**, 642.

SEBASTIAN R., near its mouth, Fla. (S.) (Br. of Brevard and St. Lucie Counties.) PLANS.—Approv. Nov. 26, 1910, **11**, 1085.

SEEKONK (Pawtucket) **R.**, Providence, R. I. (S.) (City br.) PLANS.—Reconstr. of br., in place of "central or red" br., approv. Feb. 5, 1895, **95**, 478.

SEEKONK (Pawtucket) **R.,** Providence, R. I. (S.) (Providence Terminal Co.) PLANS.—Approv. Apr. 7, 1906, **06,** 805.

SEINE R., France. (See Thames R., England.)

SERRITOS SLOUGH, Long Beach, Cal. (S.) (Long Beach Consolidated Gas Co.) PLANS.—Approv. Apr. 28, 1911, **11,** 1088.

SEVERN R., Me. (Dr.) **02,** 581.

SEVERN R., Md. (Dr.) **11,** 1078.

SEVERN R., near Annapolis, Md. (S.) (Anne Arundel County br.) PLANS.—Rebuilding approv. Aug. 24, 1904, **05,** 723.

SHAKIT (Salt) **CREEK** and **CURRY CREEK** (Roberts B.), near Venice, Fla. (S.) (Seaboard Air Line Ry. Co.) PLANS.—2 brs. approv. May 16, 1911, **11,** 1089.

SHALLOW CREEK, Md. (See Jones Creek.)

SHEBOYGAN R., Sheboygan, Wis. (Sp., etc.) (Milwaukee, Lake Shore & Western Ry. Co.) LEGISLATION.—Company au. to constr. br. under act Sept. 19, 1890, sec. 7, and by act of Wisconsin Legislature. PLANS.—New br. approv. Dec. 23, 1891, **92,** 402.

SHEBOYGAN R., Sheboygan, Wis. (S.) (City br.) PLANS.—Br. to replace existing br. approv. Jan. 26, 1909, **09,** 917.

SHEBOYGAN R., Sheboygan, Wis. (S.) (Chicago & North Western Ry. Co.) PLANS.—Approv. Apr. 27, 1905, **05,** 726. Approv. Feb. 17, 1906, **06,** 804.

SHEEPSCOT R., at mouth of Dyers R., Sheepscot, Me. (O.) (Br. of town of New Castle.) PLANS.—Alterations to be completed by Mar. 1, 1908. Time extended to July 1, 1908. **08,** 873, 874.

SHEEPSCOT R., Edgemont, Me. (S.) (Town br.) PLANS.—Approv. Feb. 17, 1904, **04,** 717.

SHEEPSCOT R., Wiscasset and Edgecomb, Me. (S.) (Lincoln County br.) PLANS.—Approv. Aug. 7, 1905, **06,** 801.

SHINNECOCK and **PECONIC CANAL,** Suffolk County, N. Y. (S.) (Suffolk County br.) PLANS.—Approv. June 11, 1907, **07,** 828.

SHREWSBURY R., between Little Silver and Branchport, N. J. (New York & Long Branch R. R. Co.) PLANS.—Reconstr. of existing br. approv. Jan. 9, 1912, **12,** 1304.

SHREWSBURY R., Highland Beach, N. J. (Sp.) (Navesink R. R. Co.) LEGISLATION.—Company au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of New Jersey. PLANS.—Modified plan approv. Dec. 2, 1891, **92,** 401.

SHREWSBURY R., N. J. (Dr.) **06,** 797.

SHREWSBURY R., Seabright, N. J. (S.) (Monmouth County br.) PLANS.—Rebuilding approv. Dec. 8, 1900, **01,** 663.

SHREWSBURY R., S. Branch (Oceanport Creek), Oceanport, N. J. (O.) (New York & Long Branch R. R. Co.) PLANS.—Alterations to be made in either of 2 methods described on or before Sept. 1, 1896; time extended to May 1, 1897, **96,** 428.

SHUMAC CREEK, near Belhaven, N. C. (S.) (Br. of F. A. Emerick.) PLANS.—Approv. Dec. 12, 1905, **06,** 803.

SINEPUXENT R., Me. (Dr.) **05,** 719.

SINEPUXENT R., Ocean City, Md. (S.) (Baltimore, Chesapeake & Atlantic Ry. Co.) PLANS.—Reconstr. approv. Feb. 28, 1907, **07,** 826.

SIXMILE CREEK, Duval County, Fla. (S.) (County br.) PLANS.—Br. to replace an existing str. approv. May 4, 1910, **10,** 1029.

SIXMILE CREEK, Hillsboro County, near Tampa, Fla. (S.) (County br.) PLANS.—Approv. Dec. 14, 1910, **11,** 1085.

SKAGIT R., Mount Vernon, Skagit County, Wash. (Sp., etc.) (County br.) LEGISLATION.—County au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Washington. PLANS.—Modified plans approv. July 25, 1892, **92,** 407.

SKAGIT R., near Mount Vernon, Wash. (S.) (Great Northern Ry. Co.) PLANS.—Rebuilding approv. Feb. 2, 1906, **06,** 804.

SKAGIT R., near Mount Vernon, Wash. (S.) (State and county br.) PLANS.—Approv. Nov. 17, 1911, **12,** 1302.

SKAGIT R., near Mount Vernon, Wash. (S.) (Bellingham & Skagit Ry. Co.) PLANS.—Approv. Nov. 17, 1911, **12,** 1303. Instrument dated Nov. 17, 1911, revoked Feb. 16, 1912. New plans approv. Feb. 16, 1912. **12,** 1305.

SKAGIT R., Sedro-Woolley, Wash. (S.) (Skagit County br.) PLANS.—Approv. Feb. 15, 1911, **11,** 1087.

SKAGIT R., N. Fork (sec. 10, T. 33 N., R. 3 E., Willamette meridian), Wash. (S.) (Skagit County br.) PLANS.—Approv. Mar. 28, 1911, **11,** 1088.

SKAMOKAWA CREEK, Wash. (S.) (Wahkiakum County br.) PLANS.—Approv. July 30, 1894, **94,** 429.

SKIPANON R., Oreg. (Dr.) **02,** 581.

SLOUGHS ON LINE OF ABERDEEN-MONTESANO ROAD, Chehalis County, Wash. (S.) (Chehalis County brs.) PLANS.—Approv. Sept. 11, 1905, **06,** 802.

SMALL CREEK (arm of Norwalk H.), Conn. (S.) (Harbor View Realty Co.) PLANS.—Approv. Dec. 28, 1907, **08,** 871.

SMITH CREEK, at Oriental, and **ADAMS CREEK,** at Winthrop, N. C. (S.) (Virginia & Carolina Coast R. R. Co.) PLANS.—Approv. Dec. 12, 1906, **07,** 824.

SMITH CREEK, N. C. (S.) (Atlantic Coast Line Ry. Co.) PLANS.—Rebuilding approv. June 13, 1906, **06,** 808.

SMITH CREEK, Va. (Dr.) **02,** 581.

SMITHS COVE WATERWAY, at W. Garfield Street, Seattle, Wash. (S.) (City br.) PLANS.—Temporary br. approv. May 4, 1910, **10,** 1029.

SMITHS COVE WATERWAY, Seattle, Wash. (S.) (City br.) PLANS.—Approv. Sept. 6, 1910, **11**, 1083.

SNAKE R., between Lewiston, Idaho, and Concord, Wash. (Sp.) (Lewiston-Concord Br. Co.) LEGISLATION.—Company au. to constr. br. by act Feb. 15, 1898. PLANS.—Submitted Nov. 26, 1897; modified July 6, 1898; approv. Aug. 24, 1898, **98**, 532.

SNAKE R., Nome City, Alaska. (Sp.) (Cape Nome Transportation, Br. & Development Co.) LEGISLATION.—Company au. to constr. br. by act May 4, 1900, **00**, 698. PLANS.—Approv. May 21, 1900, **00**, 698.

SNAKE R., at Ontario, Oreg. (Sp.) (Malheur County br.) Au. act Feb. 3, 1910. PLANS.—Approv. May 5, 1910, **10**, 1022.

SNAKE R., Payette, Idaho. (Sp.) (Snake R. Br. Commission.) Au. act Mar. 4, 1911. PLANS.—Approv. Aug. 25, 1911, **12**, 1295, 1296.

SNAKE R., near Texas Ferry, Wash. (Sp.) (Oregon Ry. & Navigation Co.) LEGISLATION.—Company au. to constr. br. by act July 9, 1888, **89**, 370. PLANS.—Approv. Feb. 19, 1889. Br. completed Apr. 30, 1889. **89**, 370.

SNODGRASS SLOUGH, Cal. (S.) (Sacramento Southern R. R. Co.) PLANS.—Approv. Apr. 12, 1910, **10**, 1029.

SNOHOMISH R., Everett, Wash. (Sp., etc.) (Land River Imp. Co. of Everett.) LEGISLATION.—Company au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Washington. PLANS.—Approv. June 2, 1892, **92**, 406.

SNOHOMISH R., Everett, Wash. (S.) (Seattle & Montana R. R. Co.) PLANS.—Approv. Oct. 10, 1901, **02**, 585.

SNOHOMISH R., Everett, Wash. (S.) (City br.) PLANS.—Approv. Jan. 7, 1904, **04**, 716. Reconstr. approv. Aug. 21, 1906, **07**, 821.

SNOHOMISH R., n. of Everett, Wash. (S.) (Great Northern Ry. Co.) PLANS.—Modified plans approv. July 13, 1911, in lieu of approv. of Oct. 10, 1901, covering location and plans of br. proposed by Seattle & Montana R. R. Co. Instrument approv. Oct. 10, 1901, revoked, **12**, 1299.

SNOHOMISH R. (sec. 32, T. 29 N., R. 5 E.) and Ebey Slough (sec. 4, T. 28 N., R. 5 E.), Willamette meridian, Wash. (Sp., etc.) (Snohomish, Skykomish & Spokane Ry. & Transportation Co.) LEGISLATION.—Company au. to constr. brs. under act Sept. 19, 1890, sec. 7, and act of Washington. PLANS.—Approv. Oct. 30, 1891. Br. across Ebey Slough reported completed in accordance with approv. plan, but br. across Snohomish R. had but 1 clear draw opening of 99′, instead of 2 of 100′ each, as required. R. dated Apr. 4, 1892. **92**, 400.

SNOHOMISH R., Snohomish, Wash. (Sp., etc.) (City br.) LEGISLATION.—City au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Washington, **92**, 400. PLANS.—Approv. July 22, 1891. Completion of br. reported on Dec. 5, 1891. **92**, 400.

SNOHOMISH R., near Snohomish City, Wash. (Sp., etc.) (St. Paul, Minneapolis & Manitoba Ry. Co.) LEGISLATION.—Company au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Washington, **92**, 407. PLANS.—Modified plan approv. July 28, 1892, **92**, 407.

SNOHOMISH R., at Snohomish, Wash. (S.) (Northern Pacific Ry. Co.) PLANS.—Reconstr. existing br. approv. July 13, 1909, **10**, 1023.

SNOQUALMIE R., Cherry Valley, Wash. (S.) (King County br.) PLANS.—Approv. Jan. 24, 1906, **06**, 803.

SNOQUALMIE R., Novelty, Wash. (S.) (King County br.) PLANS.—Approv. Sept. 14, 1899, **00**, 699.

SNOQUALMIE R., Wash. (S.) (Snohomish County br.) PLANS.—Approv. June 9, 1896, **96**, 426.

SNOQUALMIE R., near Tolt, Wash. (S.) (King County br.) PLANS.—Approv. Nov. 22, 1899, **00**, 700. Approv. Apr. 8, 1902, **02**, 588.

SOMERS COVE, Md. (Dr.) **08**, 865.

SONOMA CREEK, Sonoma County, Cal. (S.) (Bay Counties Ry. Co.) PLANS.—Approv. July 16, 1906, **07**, 820.

SOPCHOPPY R. (See Ocklockonee R.)

SOUTH B., Elk R., between Bay City and Laidlaw, Wash. (Sp., etc.) (Chehalis County br.) LEGISLATION.—County au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Washington. PLANS.—Modified plan approv. Aug. 15, 1892, **92**, 408.

SOUTH CREEK, near Aurora, N. C. (S.) (Washington & Vandemere R. R. Co.) PLANS.—Approv. July 26, 1906, **07**, 820.

SOUTH CREEK, Aurora, N. C. (S.) (Beaufort County br.) PLANS.—Approv. Sept. 16, 1910, **11**, 1083.

SOUTH FORKED DEER R., Tenn. (A.) (2 R. R. and 5 county brs.) PLANS.—Removal of such of the brs. as are unused recom., and the insertion of draws in the others, **88**, 2554.

SOUTH FORKED DEER R., Bells Depot, Tenn. (O.) (Louisville & Nashville R. R. Co.) PLANS.—Specified alterations required within 6 months from Nov. 21, 1895. Alterations completed. **96**, 428.

SOUTH R., Md. (Dr.) **07**, 815.

SOUTH R., N. J. (O. and S.) (Raritan River R. R. br.) **89**, 376. PLANS.—Alterations required by June 1, 1889; time extended to July 11, 1889, then to July 21, 1889; no action taken, **89**, 377. Reconstr. approv. Jan. 29, 1910, **10**, 1026.

SOUTH R., Sayreville and South River, N. J. (S.) (Raritan River R. R. Co.) PLANS.—Reconstr. approv. July 19, 1907, **08**, 868.

SOUTH R., Union Street, Salem, Mass. (S.) (City br.) PLANS.—Approv. Oct. 18, 1910, **11**, 1084.

SOUTH SLOUGH, Coos County, Oreg. (S.) (Coos County br.) PLANS.—Approv. Dec. 12, 1908, **09**, 916.

SPA CREEK, Md. (Dr.) **09,** 912.

SPOKANE R., near Coeur d'Alene, Idaho. (S.) (Northern Pacific Ry. Co.) PLANS.—Approv. Apr. 7, 1905, **05,** 726.

SPOKANE R., near Gibbs, Idaho. (S.) (Idaho & Western Ry. Co.—Chicago, Milwaukee & Puget Sound Ry. Co.) PLANS.—Approv. Dec. 14, 1910, **11,** 1085. Modification of instrument approv. Jan. 26, 1911, **11,** 1086.

SPUYTEN DUYVIL CREEK, N. Y. (O.) (New York Central & Hudson River R. R. Co.) PLANS.—Specified alterations required on or before Dec. 1, 1891, **91,** 435. Plans for new br. approv. Aug. 28, 1894, **94,** 430. Plans for temporary br. approv. Nov. 22, 1897. **98,** 534.

SQUAK SLOUGH (Sammamish R.), near Redmond, Wash. (S.) (King County br.) PLANS.—Rebuilding approv. Mar. 19, 1909, **09,** 917.

STATEN ISLAND SOUND, Arthur Kill. (Sp.) COMMERCE.—Dimensions of tows, **87,** 2633; **88,** 2424. Height of vessel masts, **87,** 2634. ENGINEERS. Chief of Engineers. **Rs., 87,** 337, 2637; **88,** 308, 2421. BE. **R.** of board of 1886, **87,** 2632. Convened at New York City, Apr. 10, 1888, by S. O. Nos. 8 and 9, to ex. and **R.** upon Staten Isld. Br. **R., 88,** 2423, 2429. (Col. Casey and Lt. Cols. Robert and Hains.) Minority **R., 88,** 2426. (Maj. King and Capt. Maguire.) LEGISLATION.—Br. au. by act June 16, 1886, **87,** 337. Act au. constr. of br. at Arthur Kill, **88,** 2426. PLANS.—Description of alterations as proposed by the board, **88,** 2425. Description of plans proposed, **87,** 2635.

STATEN ISLAND SOUND, Westfield, N. Y. (Sp.) ENGINEERS.—Chief of Engineers. **R., 88,** 308. BE. convened at New York City, Apr. 10, 1888, by S. O. Nos. 8 and 9, to ex. and **R.** upon constr. of a br. at Westfield, N. Y., across Staten Isld. Sound. **R., 88,** 2430. (Col. Casey, Lt. Cols. Robert and Hains, Maj. King, and Capt. Maguire.) LEGISLATION.—Au. by Senate bill 1850, **88,** 2430. PLANS.—Board **R.** adversely to a draw and recom. a cantilever br. of 3 bays, the center bay to be not less than 900′ in the clear, with a clear height over the chan. way at m. h. w. of 150′, **88,** 2430.

STEAMBOAT R., Minn. (S.) (St. Paul, Minneapolis & Manitoba Ry. Co.) PLANS.—Approv. Mar. 14, 1898, **98,** 534.

STEAMBOAT SLOUGH, near Marysville, Wash. (S.) (Great Northern Ry. Co.) PLANS.—Rebuilding approv. Feb. 2, 1906, **06,** 804.

STEAMBOAT (or Schell) **SLOUGH,** Sonoma County, Cal. (O.) (California Northwestern Ry. Co.) PLANS.—Alterations to be completed on or before Sept. 15, 1906, **06,** 809.

STEELE BAYOU, at Lakeside, Magnolia, Willette, Catchings, Griffin, Scott, and Mauny, Miss. (S.) (Issaquena County brs.) PLANS.—For 7 brs. approv. May 5, 1911, **11,** 1089.

STEILACOOM CREEK WATERWAYS. (See Wilton Waterway.)

STILLAGUAMISH R., Wash. (S.) (Snohomish County br.) PLANS.—Approv. July 13, 1894, **94,** 429.

STILAGUAMISH R., near Arlington, Wash. (S.) (Seattle & International Ry. Co.) PLANS.—Approv. June 14, 1901, **01,** 667.

STILAGUAMISH R., near Arlington, Wash. (S.) (Marysville & Northern Ry. Co.) PLANS.—Approv. Sept. 29, 1905, **06,** 802.

STILAGUAMISH R., near Arlington, Wash. (S.) (Marysville & Arlington Ry. Co.) PLANS.—Approv. Feb. 6, 1908, **08,** 871.

STILAGUAMISH R., near Florence, Wash. (S.) (Snohomish County br.) PLANS.—Approv. Mar. 3, 1904, **04,** 717. Approv. July 14, 1909, **10,** 1023.

STILAGUAMISH R., near Norman, Wash. (S.) (Snohomish County br.) PLANS.—Approv. July 26, 1911, **12,** 1300.

STILAGUAMISH R., near Silvana, Wash. (S.) (Great Northern Ry. Co.) PLANS.—Reconstr. approv. July 27, 1904, **05,** 722.

STILAGUAMISH R., near Stanwood, Wash. (S.) (Snohomish County br.) PLANS.—Approv. Sept. 24, 1908, **09,** 915.

STILAGUAMISH R., Thomle Ferry, near Florence, Wash. (S.) (Snohomish County br.) PLANS.—Approv. May 25, 1906, **06,** 807.

STONE HOUSE COVE, Curtis B., Md. (A.) (Anne Arundel County br.) PLANS.—Proceedings instituted; turntable p. with 30′ opening on each side required on or before Dec. 31, 1899; reconstr. plans in accordance approv. Aug. 10, 1899, **99,** 624, 626.

STONY CREEK, at Branford, **WEST R.,** at Guilford, **EAST** and **HAMMONASSET RS.,** at Madison, **MENUNKETESUCK** and **PATCHOGUE RS.,** near Westbrook, and **OYSTER R.,** at Old Saybrook, Conn. (S.) (Shore Line Electric Ry. Co.) PLANS.—Approv. Aug. 9, 1909, **10,** 1024.

STURGEON B., Wis. (S.) (Ahnapee & Western Ry. Co.) PLANS.—Approv. Apr. 30, 1894, **94,** 428.

STURGEON B., Wis. (O.) (Sturgeon Bay Br. Co.) PLANS.—Required substantial work to replace the p. protection and to protect the abutments with suitable lines of fender piling on or before Mar. 15, 1900, **00,** 702.

STURGEON B., at Sturgeon B., Wis. (O.) (Sturgeon Bay Br. Co. and Ahnapee & Western Ry. Co.) PLANS.—Alterations to be completed on or before 1 year from Apr. 8 and 16, 1907, the dates of service of notices on the companies, **07,** 829.

STURGEON B. (chan. across), Wis. (S.) (City br.) PLANS.—Reconstr. of pile trestle approach to existing br. approv. Mar. 14, 1912, **12,** 1306.

SULLIVANS ISLD., Charleston H., across cove, S. C. (S.) (Mount Pleasant & Seaview City R. R. Co.) PLANS.—Approv. Apr. 18, 1893,

93, 469. Company ordered, Feb. 20, 1894, to remove some piles and a swing br. from the center p., to be done within 30 days; afterwards extended to 60 days, **94**, 431.

SULPHUR R., Ark. (Sp.) (Texarkana & Shreveport R. R. Co.) LEGISLATION.—Company au. to constr. br. by act May 28, 1894, **95**, 474. PLANS.—Approv. Oct. 16, 1894, **95**, 474.

SULPHUR R., Ark. (Sp.) (Kansas City Southern Ry. Co.) Au. Feb. 8, 1897. PLANS.—Approv. Mar. 25, 1901, **01**, 660.

SUMMER CREEK, Middletown, Conn. (S.) (New York, New Haven & Hartford R. R. Co.) PLANS.—Reconstr. plans approv. Sept. 6, 1910, **11**, 1083.

SUNFLOWER R., near Baird Station, Miss. (Sp.) (Southern R. R. Co. in Mississippi, successors to Georgia Pacific R. R. Co.) Au. act Mar. 3, 1887. PLANS.—Approv. Oct. 9, 1911, **12**, 1296.

SUNFLOWER R., Lehrton, Miss. (Sp.) (Sunflower County br.) Au. act June 28, 1906. PLANS.—Approv. Aug. 15, 1906, **07**, 817.

SUNFLOWER and **YAZOO RS.** (Sp.) (Georgia Pacific R. R. Co.) **88**, 309, 2488. LEGISLATION.—Br. au. by act Mar. 3, 1887, **88**, 2488. PLANS.—Capt. Willard approv. of proposed br. dimensions with the recom. that draw opening be increased from 115′ in the clear to 125′, **88** 2488.

SUSQUEHANNA R. (See Christiana R., Wilmington, Del., etc.)

SUSQUEHANNA R., N. Branch of. (See Schuylkill R.)

SUSQUEHANNA R., Havre de Grace, Md. (S.) (Baltimore & Ohio R. R. Co.) PLANS.—Rebuilding approv. June 19, 1907, **07**, 828. Reconstr. approv. July 27, 1908, **09**, 914.

SUSQUEHANNA R., Havre de Grace, Md. (S.) (Havre de Grace & Perryville Br. Co.) PLANS.—Reconstr. approv. Oct. 22, 1908, **09**, 915.

SUSQUEHANNA R., between Havre de Grace and Perryville, Md. (S.) (Philadelphia, Baltimore & Washington R. R. Co.) PLANS.—Br. to replace existing str. approv. Apr. 28, 1904, **04**, 718.

SUWANEE R., Fla. (S.) (Suwanee & San Pedro R. R. Co.) PLANS.—Approv. Aug. 9, 1901, **02**, 584.

SUWANEE R., Fla. (S.) (Atlantic Coast Line R. R. Co.) PLANS.—Approv. Apr. 15, 1905, **05**, 726.

SUWANEE R., Bradford, Fla. (S.) (Br. of Lafayette and Suwanee Counties.) PLANS.—Approv. July 16, 1906, **07**, 820.

SUWANEE R., Dowling Park, Fla. (S.) (Br. of Lafayette and Suwanee Counties.) PLANS.—Approv. Jan. 11, 1912, **12**, 1304.

SUWANEE R., Lurayville, Fla. (S.) (Br. of Lafayette and Suwanee Counties.) PLANS.—Approv. Oct. 12, 1906, **07**, 822.

SWAN CREEK, Toledo, Ohio. (S.) (Lake Shore & Michigan Southern Ry. Co.) PLANS.—Reconstr. plans approv. Sept. 15, 1896, **97**, 531.

SWAN CREEK, Toledo, Ohio. (S.) (Lima & Toledo Traction Co.) PLANS.—Approv. Mar. 2, 1908, **08**, 872.

SWAN CREEK, Green Street, Toledo, Ohio. (S.) (City br.) PLANS.—Approv. Mar. 31, 1905, **05**, 726.

SWAN CREEK, Monroe Street, Toledo, Ohio. (S.) (Lake Shore & Michigan Southern Ry. Co.) PLANS.—Approv. Aug. 1, 1907, **08**, 868.

SWIFT CREEK, Vanceboro, N. C. (O.) (Craven County br.) PLANS.—Alterations to be completed on or before Jan. 1, 1904, **04**, 721.

SWIFT CREEK (at Vanceboro) and **BRICES CREEK**, N. C. (S.) (Craven County br.) PLANS.—Approv. Aug. 3, 1907, **08**, 869.

SWIFTS R., Onset, Mass. (S.) (Middleboro, Wareham & Buzzards Bay Street Ry. Co.) PLANS.—Approv. July 18, 1901, **02**, 583.

SWINOMISH SLOUGH, Wash. (O.) (Seattle & Northern R. R. Co.) PLANS.—Required alterations to be completed on or before Jan. 1, 1891; time informally extended to Apr. 1, 1891. Officer in charge reported that the work would probably be completed by Oct. 9, 1891. **91**, 433.

SWINOMISH SLOUGH, near La Conner, Wash. (S.) (Skagit County br.) PLANS.—Approv. Mar. 6, 1907, **07**, 825.

SWINOMISH SLOUGH, Skagit County, Wash. (Sp., etc.) (County br.) LEGISLATION.—County au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Washington, **92**, 404. PLANS.—Approv. Apr. 21, 1892, **92**, 404.

T.

TACOMA, across the ship chan., Wash. (S.) (Tacoma city br.) PLANS.—Approv. Sept. 29, 1893. Upon the city's application of Oct. 30, 1893, the Sec. of War au., Nov. 15, 1893, certain modifications of the specified conditions respecting the location of ps. **94,** 426.

TACOMA (city waterway), Wash. (S.) (Oregon & Washington R. R. Co.) PLANS.—Approv. Dec. 28, 1907, **08,** 871. Modified plans approv. Jan. 20, 1910, **10,** 1026. Further modification approv. Feb. 9, 1911, **11,** 1086.

TACOMA CITY WATERWAY, S. 11th Street, Tacoma, Wash. (S.) (City br.) PLANS.—Reconstr. approv. Jan. 11, 1907, **07,** 824.

TACOMA, WASH. (Dr.) **11,** 1078.

TALLAHATCHIE R., Miss. (Sp.) (Quitman County br.) Au. act Mar. 3, 1905. PLANS.—Approv. May 21, 1906, **06,** 800.

TALLAHATCHIE R., near Ashwood Landing, Miss. (S.) (Leflore County br.) PLANS.—Approv. Oct. 29, 1909, **10,** 1025.

TALLAHATCHIE R., near Minter City, Miss. (S.) (Leflore County br.) PLANS.—Approv. Oct. 26, 1911, **12,** 1302.

TALLAHATCHIE R., Philipp, Miss. (Sp.) (Delta Cooperage Co., and the Yazoo & Mississippi Valley R. R. Co.) LEGISLATION.—Company au. to constr. br. by act May 28, 1896. PLANS.—Approv. June 1, 1897, **97,** 530; and Oct. 14, 1911, **12,** 1296.

TALLAHATCHIE R., Shell Mound, Miss. (S.) (Leflore County br.) PLANS.—Approv. Dec. 14, 1910, **11,** 1085.

TALLAHATCHIE R., near Swan Lake, Miss. (Sp.) (Tallahatchie County br.) LEGISLATION.—County au. to constr. br. by act Mar. 1, 1900. PLANS.—Approv. June 25, 1900, **00,** 698.

TANNERS CREEK, near Norfolk, Va. (S.) (Norfolk Ry. & Light Co.) PLANS.—Approv. Feb. 15, 1900, **00,** 700.

TANNERS CREEK, near Norfolk, Va. (S.) (Norfolk & Atlantic Terminal Co.) PLANS.—Approv. Jan. 18, 1899, **99,** 621.

TANNERS CREEK, Va. (A.) (Tanners Creek Drawbr. Co.) PLANS.—Proceedings having been instituted against the company, reconstr. plans, providing for an increased width of draw opening, and to be in lieu of changes required in notice dated May 16, 1896, approv. June 23, 1896, **96,** 427.

TANNERS CREEK, Va. (Dr.) **02,** 581; **07,** 815.

TAR R. (See Pamlico R.)

TAR R., Greenville, N. C. (S.) (Pitt County br.) PLANS.—Approv. Oct. 7, 1907, **08,** 870.

TAR R., Pillsboro Landing, N. C. (S.) (Pitt County br.) PLANS.—Approv. June 7, 1904, **04,** 719.

TAR R., Tarboro, N. C. (Sp., etc.) (Albemarle & Raleigh R. R. Co.) LEGISLATION.—Company au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of North Carolina. PLANS.—New br. approv. Aug. 8, 1892, **92,** 408.

TAR R., Tarboro, and Bells Br., 13 m. above Tarboro, N. C. (O. and S.) (Edgecombe County brs.) PLANS.—Each br. to have a draw span, with clear openings of 30′, to be placed over the middle chan., the openings parallel with current and draws easily worked, to be completed on or before Feb. 1, 1896, **95,** 483. Reconstr. plans for the Tarboro br. approv. June 5, 1896, **96,** 426.

TAR R., Washington, N. C. (S.) (Washington & Vandemere R. R. Co.) PLANS.—Approv. Sept. 7, 1904, **05,** 724.

TAUNTON GREAT R., between Dighton and Berkley, Mass. (S.) (Bristol County br.) PLANS.—Reconstr. plans approv. Aug. 11, 1896, **96,** 427.

TAUNTON GREAT R., between Fall R. and Somerset, Mass. (S.) (Bristol County br.) PLANS.—Reconstr. of existing br. approv. Jan. 22, 1912, **12,** 1304.

TAUNTON R., Mass. (Dr.) **11,** 1078.

TAUNTON R., Mass., Somerset to Fall R. (O.) (Old Colony R. R. Co.) **88,** 2659; **89,** 374; **90,** 340. LEGISLATION.—Referred to Dept. of Justice with request that action be taken as prescribed by law, **89,** 375. Notice served as to alterations required, **90,** 340. PLANS.—Maj. Livermore recom. placing draw protection parallel to the current, and increasing the draw opening, **88,** 2659. Alterations required by May 1, 1889. No action taken. **89,** 375.

TAUNTON R., at Fall R., Mass. (S.) (State br.) PLANS.—Approv. June 2, 1906, **06,** 807.

TAUNTON R., Somerset, Mass. (S.) (New York, New Haven & Hartford R. R. Co.) PLANS.—Approv. May 9, 1906, **06,** 806.

TAUNTON R., Taunton, Mass. (S.) (City br.) PLANS.—Rebuilding approv. Aug. 24, 1903, **04,** 714.

TAYLORS BAYOU, Tex. (S.) (Jefferson County br.) PLANS.—Approv. June 30, 1896, **96,** 426. Reconstr. plans, to replace the one destroyed by storm, approv. Mar. 28, 1898, **98,** 535.

TAYLORS BAYOU, near Port Arthur, Tex. (S.) (Jefferson County br.) PLANS.—Approv. Apr. 14, 1904, **04,** 718.

TAYLORS BAYOU (br. in place of that at 7th Street Road), Port Arthur, Tex. (S.) (Jefferson County br.) PLANS.—New br. at new location approv. Mar. 6, 1911, **11**, 1087.

TCHOUTACABOUFFA R., below Morris Ferry, Miss. (S.) (Harrison County br.) PLANS.—Approv. Aug. 27, 1908, **09**, 915.

TCHULA LAKE, Mileston, Miss. (S.) (Holmes County br.) PLANS.—Approv. Sept. 14, 1909, **10**, 1024.

TCHULA LAKE, near Marksville, Miss. (S.) (Holmes County br.) PLANS.—Approv. Oct. 20, 1910, **11**, 1084.

TECHE BAYOU, Bayside Plantation, near Jeanerette, La. (S.) (H. Shelby Sanders. PLANS.—Approv. June 1, 1907, **07**, 828.

TECHE BAYOU, Breaux Br., St. Martinville, La. (S.) (St. Martin Parish br.) PLANS.—Approv. July 8, 1898, **98**, 536.

TECHE BAYOU, near Breaux Br., La. (S.) (Morgan's Louisiana & Texas R. R. & S. S. Co.) PLANS.—Approv. Apr. 4, 1906, **06**, 805.

TECHE BAYOU, Bullards Cove, La. (S.) (St. Martin Parish br.) PLANS.—Approv. Sept. 11, 1899, **00**, 698.

TECHE BAYOU, Calumet Plantation, La. (S.) (Daniel Thompson's br.) PLANS.—Approv. May 5, 1898, **98**, 535.

TECHE BAYOU, Centerville, La. (S.) (Br. of Messrs. Mariero, Schwan & Mariero.) PLANS.—Br. to replace existing str. approv. Mar. 20, 1906, **06**, 805.

TECHE BAYOU, near Charenton, La. (o.) (Iberia, St. Mary & Eastern R. R. Co.) PLANS.—Approv. Dec. 8, 1911, **12**, 1303.

TECHE BAYOU, Franklin, La. (S.) (St. Mary Park Association.) PLANS.—Modified plans approv. May 7, 1903, **03**, 650.

TECHE BAYOU, Jeanerette, La. (S.) (Town br.) PLANS.—Approv. Nov. 13, 1896, **97**, 532.

TECHE BAYOU, near Leonville, La. (S.) (Morgan's Louisiana & Texas R. R. & S. S. Co.) PLANS.—Approv. June 11, 1906, **06**, 807.

TECHE BAYOU, near Loreauville, La. (S.) (Adrien Gonsoulin's br.) PLANS.—Approv. July 26, 1894, **94**, 429.

TECHE BAYOU, New Iberia, La. (S.) (Mrs. Catherine Erath.) PLANS.—Approv. Sept. 8, 1903, **04**, 714.

TECHE BAYOU, near Oaklawn Plantation, St. Mary Parish, La. (S.) (Iberia, St. Mary & Eastern R. R. Co.) PLANS.—Approv. Apr. 6, 1912, **12**, 1307.

TECHE BAYOU, in parish of St. Mary, La. (S.) (Shadyside Co., Ltd.) PLANS.—Approv. July 13, 1911, **12**, 1299.

TECHE BAYOU, Ruth Plantation, St. Martin Parish, La. (S.) (R. Martin Sugar Co., Ltd.) PLANS.—Approv. Apr. 20, 1899, **99**, 622.

TECHE BAYOU, St. Johns Plantation, St. Martin Parish, La. (S.) (J. B. Levert's br.) PLANS.—Approv. Sept. 11, 1899, **00**, 699.

TECHE BAYOU, St. Martin Parish, La. (S.) (J. B. Levert's br.) PLANS.—Approv. Apr. 29, 1897, **97**, 534.

TECHE BAYOU, St. Martin Parish, La. (S.) (Br. of Frank O. Broussard.) PLANS.—Approv. Oct. 23, 1905, **06**, 803.

TECHE BAYOU, near St. Martinville, La. (S.) (Keystone Plantation, John Peters, agent.) PLANS.—Reconstr. plans approv. Aug. 18, 1896, **96**, 427.

TECHE BAYOU, St. Martinville, St. Martin Parish, La. (S.) (City br.) PLANS.—Approv. July 28, 1897, **97**, 534.

TECHE BAYOU, Sarah Plantation, La. (S.) (Iberia Parish br.) PLANS.—Approv. May 21, 1907, **07**, 827.

TECHE BAYOU, Sorrell Plantation, La. (S.) (J. N. Pharr & Sons, Ltd.) PLANS.—Approv. May 22, 1907, **07**, 827.

TECHE BAYOU, near Wyche Plantation, La. (S.) (New Iberia, St. Martin & Northern R. R. Co.) PLANS.—Approv. Sept. 3, 1908, **09**, 915.

TECHE BAYOU, La. (S.) (New Iberia & Northern R. R. Co.) PLANS.—Approv. July 20, 1910, **11**, 1082.

TENNESSEE R. (Dr.) **02**, 581.

TENNESSEE R. (See Ohio R.)

TENNESSEE R. (O.) LEGISLATION.—Notice served upon the East Tennessee, Virginia & Georgia and the Memphis & Charleston R. R. companies as to required alterations, **90**, 339.

TENNESSEE R., Chattanooga. (Sp.) (Memphis & Charleston R. R. Co.) **88**, 309, 2513. LEGISLATION.—Br. au. by act Feb. 28, 1887, **88**, 2510. PLANS.—Modified plans submitted, giving 270′ in the clear, would afford no obstacle to existing navigation, **88**, 2512.

TENNESSEE R., between W. 6th and 19th Streets, Chattanooga, Tenn. (Sp.) (Hamilton County br.) Au. act Feb. 15, 1911. PLANS.—Approv. July 31, 1911, **12**, 1295.

TENNESSEE R., Douglas Street, Chattanooga, Tenn. (Sp.) (Hamilton County br.) Au. act Feb. 15, 1911. PLANS.—Approv. July 31, 1911, **12**, 1295.

TENNESSEE R., Danville, Tenn. (S.) (Louisville & Nashville R. R. Co.) PLANS.—Reconstr. plans approv. June 14, 1898, **98**, 536.

TENNESSEE R., Decatur, Ala. (S.) (Southern Ry. Co.) PLANS.—Reconstr. approv. Sept. 8, 1900, **01**, 662.

TENNESSEE R., Florence, Ala.; Decatur, Ala.; Bridgeport, Ala.; Johnsonville, Tenn.; and Gilbertsville, Ky. (A.) (5 brs.) **88**, 2638. PLANS.—Lt. Col. Barlow reported that the interests of navigation required the abatement or material modification of the Florence br., and that the draw spans of the brs. at Bridgeport, Johnsonville, and Gilbertsville should be enlarged to 150′ in the clear, **88**, 2640.

TENNESSEE R., Florence, Ala. (O.) (East Tennessee, Virginia & Georgia Ry. Co.)

PLANS.—Specified alterations required and completed by Sept. 1, 1891, **91**, 435.

TENNESSEE R., Florence, Ala.; Johnsonville, Tenn.; and Gilbertsville, Ky. (A.) (Memphis & Charleston R. R.; Nashville, Chattanooga & St. Louis R. R.; and Chesapeake, Ohio & Southwestern R. R.) **88**, 2562. PLANS.—Maj. King recom. removal and relocation of the draws in these brs., **88**, 2563. Tabular statement of brs. on the Tennessee and Cumberland Rs., **88**, 2565.

TENNESSEE R., Florence, Ala. (O.) (Memphis & Charleston R. R. Co.) PLANS.—Alterations required by June 1, 1889; time extended to Dec. 1, 1889, **89**, 374.

TENNESSEE R., Gilbertsville, Ky. (Sp.) (Chicago, St. Louis & New Orleans R. R. Co.—Illinois Central R. R.) Rebuilding au. act Mar. 17, 1904. PLANS.—Rebuilding approv. Apr. 28, 1904, **04**, 712.

TENNESSEE R., Johnsonville, Tenn. (Sp., etc.) (Nashville, Chattanooga & St. Louis Ry. Co.) **90**, 340; **92**, 401; **93**, 472. LEGISLATION.—Company au. to constr. new br. under acts Aug. 11, 1888, and Sept. 19, 1890, sec. 4, **90** 340; **92**, 401. PLANS.—Proceedings being begun anew under the above acts, plans for new br., to replace the old one, approv. Nov. 19, 1891. New br. to be completed and such portions of old str. as would obstr. navigation removed on or before Nov. 15, 1894; modified plans for altering old br. approv. Apr. 13, 1893. **92**, 401; **93**, 472.

TENNESSEE R., Knoxville, Tenn. (Sp.) (Marietta & North Georgia R. R. Co., successors to the Knoxville Southern R. R. Co.) LEGISLATION.—Company au. to constr. br. by act Aug. 9, 1890; amended as to time within which the br. was to be commenced and completed by act July 26, 1892, **93**, 463. OPERATIONS.—On Feb. 8, 1893, br. reported completed, **93**, 463. PLANS.—Knoxville Southern R. R.'s plan approv. Feb. 27, 1890. Modified plans of the Marietta & North Georgia R. R. Co. approv. Sept. 29, 1892, but merger of companies not recognized. **93**, 463.

TENNESSEE R., Knoxville, Tenn. (Sp.) (Knox County br.) LEGISLATION.—County au. to replace existing str. by act Mar. 28, 1896. PLANS.—To replace the existing str. approv. June 13, 1896, **96**, 424.

TENNESSEE R., London, Tenn. (A.) (Southern Ry. Co.) PLANS.—Reconstr. approv. Mar. 13, 1905, **05**, 728.

TENNESSEE R. (Little), near Niles Ferry, Tenn. (O.) (Marietta & North Georgia Ry. Co.) PLANS.—Specified alterations required on or before Jan. 1, 1892, **91**, 435.

TENNESSEE (Little Tennessee) **R.**, Niles Ferry, Tenn. (O. and A.) (Atlanta, Knoxville & Northern Ry. Co.) PLANS.—Alterations to be completed on or before 1 year after Apr. 8, 1901, **01**, 668.

TENNESSEE R., at Oats Isld. and Mullens Cove, Marion County, Tenn. (Sp.) (Memphis-Chattanooga R. R.—Southern Ry. system.) Au. act Feb. 1, 1905. PLANS.—Approv. Apr. 13, 1905, **05**, 721.

TENNESSEE R., Perryville, Tenn. (Sp.) (Tennessee Midland R. R. Co.) LEGISLATION.—Au. by act May 14, 1888. PLANS.—Revised plan and location submitted and approv. by the Sec. of War, Aug. 21, 1889, **90**, 336.

TENSAS R., Daniels Ferry, La. (Sp.) (The New Orleans, Natchez & Fort Scott R. R. Co.) LEGISLATION.—Au. by act Mar. 1, 1889. PLANS.—Plan and location submitted and approv. by Sec. of War, Dec. 19, 1889, **90**, 337.

TENSAS R., near Daniels Ferry, La. (S.) (New Orleans & Northwestern R. R. Co.) PLANS.—Rebuilding approv. Oct. 29, 1908, **09**, 916.

TENSAS R., Ala. (Dr.) **08**, 865.

TENSAS R., near Mobile, Ala. (S.) (Louisville & Nashville R. R. Co.) PLANS.—Reconstr. plans approv. Sept. 28, 1899, **00**, 699.

TERREBONNE BAYOU, Presque Isle Plantation, near Houma, La. (S.) (Br. of parish of Terrebonne, La.) PLANS.—Approv. Aug. 25, 1911, **12**, 1301.

THAMES R., England, and **SEINE R.**, France. PROJECTS.—Description of brs. crossing both Rs., **75**, ii, 228.

THAMES R., entrance to Long and Clarks Cove, Conn. (S.) (Norwich & Worcester R. R. Co.) PLANS.—Openings to be left at these localities (between Allyns Pt. and Groton) approv. July 11, 1898, **98**, 536.

THAMES R., near New London, Conn. (Sp.) BE. **R.**, **84**, 1770. (Col. Newton, Lt. Col. Elliot, and Maj. McFarland, U. S. Army, and Capt. Phythian and Comdr. Mahan, U. S. Navy.) LEGISLATION.—Br. au. by act Mar. 3, 1883, **84**, 269. PLANS.—The following modifications were recom. by BE. and approv. by Sec. of War: Br. to be raised to leave a clear height of 30′ at h. w.; draw to be provided with suitable p. rests; steam fog signal and suitable lights to be attached to the br., **84**, 1770.

THAMES R., at New London, Conn. (S.) (New York, New Haven & Hartford R. R. Co.) PLANS.—Br. to replace an existing str. approv. Feb. 10, 1910, **10**, 1027.

THAMES R., Smiths Cove, New London, Conn. (O.) (Central Vermont Ry. Co. and New London R. R. Co.) PLANS.—Alterations to be completed within 30 days from June 17 and 18, 1903, **03**, 652.

THOROFARE (inside), Albany Avenue, Atlantic City, N. J. (S.) (Atlantic County br.) PLANS.—Approv. Jan. 3, 1901, **01**, 664. Reconstr. of existing br. approv. June 5, 1912, **12**, 1307.

THOROUGHFARE, Atlantic City, N. J. (S.) (West Jersey & Seashore R. R. Co.) PLANS.—Approv. Feb. 24, 1906, **06**, 804.

THOROUGHFARE (inside), Ventnor, N. J. (S.) (Atlantic County br.) PLANS.—Replacing existing str. approv. July 30, 1908, **09**, 914.

THOROUGHFARE (Gould Lake or Joe Gould Narrows), Minn. (S.) (Bass Brook town br.) PLANS.—Approv. Aug. 25, 1909, **10**, 1024.

THREE-MILE CREEK, Ala. (A.) (Mobile County br.) PLANS.—Change to drawbr. approv. Apr. 24, 1893, **93**, 473.

THREE-MILE CREEK, Ala. (Dr.) **08**, 865.

THREE-MILE CREEK, near Mobile, Ala. (A.) (Mobile & Birmingham Ry. Co.) PLANS.—Proceedings having been instituted against the R. R. company, alteration plans were approv. Nov. 29, 1893, on condition that the existing obstr. be removed by Feb. 11, 1894; time extended to May 11 and July 31, 1894, **94**, 430.

THREE-MILE CREEK, near Mobile, Ala. (S.) (Mobile County br.) PLANS.—Approv. Jan. 18, 1900, **00**, 700.

THREE-MILE CREEK, Laurent Plantation, Mobile County, Ala. (S.) (Mobile Terminal & Ry. Co.) PLANS.—Approv. Oct. 3, 1911, **12**, 1301.

TILLAMOOK R., near mouth of Trask R., Oreg. (S.) (Tillamook County br.) PLANS.—Approv. May 14, 1909, **09**, 918.

TITTABAWASSEE R., Saginaw, Mich. (S.) (Saginaw County br.) PLANS.—Br. to replace existing str. approv. Apr. 21, 1908, **08**, 872.

TITTABAWASSEE R., on line between secs. 18 and 19, T. 12 N., R. 4 E., Mich. (S.) (Saginaw County br.) PLANS.—Approv. Dec. 24, 1909, **10**, 1026.

TOLAY CREEK, Sonoma County, Cal. (S.) (Bay Counties Ry. Co.) PLANS.—Approv. July 14, 1906, **07**, 820.

TOMBIGBEE R., Miss. (Sp.) (Monroe County br.) LEGISLATION.—County au. to constr. br. by act July 7, 1896. PLANS.—Modified plans approv. Nov. 3, 1898, **99**, 618.

TOMBIGBEE R., Columbus, Miss. (S.) (Mobile & Ohio R. R. Co.) PLANS.—Rebuilding approv. Sept. 12, 1904, **05**, 724.

TOMBIGBEE R., near Fulton, Miss. (S.) (Itawamba County br.) PLANS.—Approv. Mar. 31, 1905, **05**, 726.

TOMBIGBEE R., near Ironwood Bluff, Miss. (Sp.) (Itawamba County br.) Au. act Feb. 4, 1911. PLANS.—Approv. July 13, 1911, **12**, 1295.

TOMBIGBEE R., Stones Ferry, Tenn. (Sp.) (Alabama, Tennessee & Northern R. R. Co.) Au. act Jan. 14, 1907. PLANS.—Approv. Jan. 25, 1907, **07**, 818.

TOMBIGBEE R., Waverly, Miss. (Sp.) (Georgia Pacific R. R. Co.) **88**, 309, 2508. LEGISLATION.—Br. au. by act Mar. 3, 1887, **88**, 2508. PLANS.—Br. as proposed not considered an obstr. to navigation, **88**, 2508.

TOUTLE R., near Castle Rock, Wash. (S.) (Northern Pacific Ry. Co.) PLANS.—Approv. July 9, 1910, **11**, 1081.

TOWN CREEK, N. C. (A.) (County br.) PLANS.—Capt. Bixby recom. the insertion of a draw span of 40′ clear be required, **88**, 2546.

TOWN CREEK, N. C. (S.) (Brunswick County br.) PLANS.—Approv. Oct. 15, 1909, **10**, 1024.

TOWN CREEK, Brunswick County, N. C. (A.) PLANS.—Draw opening or the removal of the br. recom., **88**, 2543.

TOWN CREEK, between Navassa and Southport, N. C. (Sp.) (Wilmington, Brunswick & Southern R. R. Co.) Au. act May 6, 1910. PLANS.—Approv. Apr. 12, 1910, **10**, 1021.

TOWN R., Quincy, Mass. (S.) (Fallon Bros.) PLANS.—Approv. Mar. 4, 1908, **08**, 872.

TOWNSEND GUT, Me. (Dr.) **04**, 710.

TOWNSEND GUT, Townsend, Me. (S.) (Town br.) PLANS.—Approv. May 1, 1896, **96**, 426.

TRACEYS CREEK and ROCK HOLE CREEK, at head of Herring B., vicinity of Tracings Landing, Md. (S.) (Anne Arundel County brs.) PLANS.—Approv. May 11, 1907, **07**, 827.

TRADEWATER R., Ky. (Sp.) (Ohio Valley R. R. Co.) **88**, 309. LEGISLATION.—Br. au. by act Feb. 21, 1887, **88**, 2472. PLANS.—Description of proposed br., **88**, 2473. Maj. Stickney reported that the br., when finished as proposed, would present no material obstacle to navigation, **88**, 2473.

TRAIL CREEK, Franklin Street, Michigan City, Ind. (A. and Sp.) (City br.) **89**, 2803; **90**, 338. LEGISLATION.—Constr. au. by acts June 29, 1888, **89**, 2803; and Apr. 22, 1890, **90**, 338. PLANS.—If properly constr., and particularly if maneuvered by steam, this br. would not obstr. navigation to any great extent, **89**, 2803. Plan and location submitted, and approv. by Sec. of War, June 4, 1890, **90**, 338.

TRAIL CREEK, 6th Street, Michigan City, Ind. (A.) (City br.) PLANS.—Partly obstr. navigation, **89**, 2803.

TRAIL CREEK, Michigan City, Ind. (S.) (Michigan Central R. R. Co.) PLANS.—Rebuilding approv. Mar. 4, 1902, **02**, 587.

TRAIL CREEK (Michigan City inner H.), Ind. (S.) (Laporte County br.) PLANS.—Approv. Aug. 19, 1901; modified plans providing for change of location of superstr. approv. Nov. 11, 1901, **02**, 584.

TRAIL CREEK, Franklin Street, Michigan City, Ind. (S.) (Laporte County br.) PLANS.—Reconstr. approv. Oct. 27, 1906, **07**, 822.

TRASK R. (See Tillamook R.)

TRENT R., Jones County, N. C. (S.) (Jones County br.) PLANS.—Rebuilding approv. Oct. 30, 1908, **09**, 916.

TRENT R., Newbern, N. C. (O.) (Atlantic & North Carolina R. R. Co.) PLANS.—Specified alterations required on or before Sept. 1, 1894; time extended to Apr. 1, 1895, **94**, 431.

TRENT R., Newbern, N. C. (S.) (Craven County br.) PLANS.—Approv. Oct. 26, 1897, **98,** 533.

TRENT R., near Polloksville, N. C. (S.) (Atlantic Coast Line br.) PLANS.—Reconstr. plans of pivot p. of draw approv. Aug. 2, 1898, **98,** 536. Protection of center p. approv. July 11, 1901, **02,** 583. Alterations to be completed within 9 months from July 22, 1907; time extended for 60 days, **08,** 873.

TRENT R., Polloksville, N. C. (S.) (Jones County br.) PLANS.—Reconstr. approv. Sept. 13, 1906, **07,** 822.

TRENT R., Polloksville, N. C. (S.) (John L. Roper Lumber Co.) PLANS.—Approv. Nov. 20, 1906, **07,** 823.

TRINITY R., Tex. (S.) (Houston, Beaumont & New Orleans R. R. Co.) PLANS.—Approv. Jan. 30, 1903, **03,** 648.

TRINITY R., Tex. (S.) (Beaumont, Sour Lake & Western Ry. Co.) PLANS.—Approv. Aug. 7, 1906, **07,** 820. Modified plans in lieu thereof approv. Oct. 31, 1907, **08,** 871.

TRINITY R., 5 m. below Dallas, Tex. (S.) (Dallas County br.) PLANS.—Br. to replace an existing str. approv. May 3, 1910, **10,** 1029.

TRINITY R., Houston Street, in Dallas, and Lancaster Avenue, in Oak Cliff, Tex. (S.) (Dallas County br.) PLANS.—Approv. Sept. 29, 1910, **11,** 1083.

TRINITY R., Hutchins Crossing, 16 m. s. of Dallas, Tex. (S.) (County br.) PLANS.—Approv. Feb. 2, 1911, **11,** 1086.

TRINITY R., Liberty County, Tex. (S.) (Gulf, Colorado & Santa Fe Ry. Co.) PLANS.—Approv. July 6, 1901, **02,** 583.

TRINITY R., Malloy Crossing, 24 m. s. of Dallas, Tex. (S.) (County br.) PLANS.—Approv. Feb. 1, 1911, **11,** 1086.

TRINITY R., above Marianna, Tex. (S.) (Houston, East & West Texas Ry. Co.) PLANS.—Reconstr. plans approv. May 8, 1897, **97,** 534.

TRINITY R., Wilmer Crossing, 21 m. s. of Dallas, Tex. (S.) (County br.) PLANS.—Approv. Feb. 2, 1911, **11,** 1086.

TROUT CREEK, Fla. (O.) (Florida Central & Peninsular R. R. Co.) PLANS.—To so arrange the draw span and remove piles as to give a clear passage through the draw span, alterations to be and were completed by July 20, 1891, **91,** 435.

TROUT CREEK, near Dinsmore, Fla. (S.) (Duval County br.) PLANS.—Approv. Mar. 16, 1910, **10,** 1028.

TROUT CREEK, near Jacksonville, Fla. (S.) (Duval County br.) PLANS.—Rebuilding approv. Dec. 28, 1907, **08,** 871.

TROUT CREEK, on the Lem Turner Road, Duval County, Fla. (S.) (County brs.) PLANS.—Approv. June 11, 1912, **12,** 1308.

TUG FORK. (See Big Sandy R.)

TUG FORK, of Big Sandy R., at or near Williamson, W. Va. (Sp.) (Williamson & Pond Creek R. R. Co.) Au. act May 11, 1912. PLANS.—Approv. June 7, 1912, **12,** 1298.

TULLS CREEK, Tulls, N. C. (O.) (Currituck County br.) PLANS.—Specified alterations required to be and were completed by June 1, 1892, **92,** 411. Alterations to be completed within 5 months from Aug. 20, 1902, **02,** 590.

TUOLUMNE R., near Tuolumne City Ferry, Cal. (S.) (Stanislaus County br.) PLANS.—Approv. Oct. 30, 1903, **04,** 715.

TYGARTS VALLEY R., W. Va. (S.) (Buckhannon & Northern R. R. Co.) PLANS.—Approv. Jan. 9, 1904, **04,** 716.

U.

U. S. CANAL. (See Muskingum R.)

U. S., FOX R., John Street, Appleton, Wis. (S.) (City br.) PLANS.—**Reconstr. plans approv. Oct. 10, 1896, 97, 532.**

V.

VERMILION R., Abbeville, La. (S.) (Vermilion Parish br.) PLANS.—Reconstr. plans approv. Sept. 23, 1895, **96**, 425.

VERMILION (Bayou) **R.**, Abbeville, La. (S.) (Southern Pacific Co., on line of Iberia & Vermilion R. R.) PLANS.—Approv. Aug. 9, 1901, **02**, 584.

VERMILION BAYOU, Dormas Broussard Crossing, La. (S.) (Lafayette Parish br.) PLANS.—Reconstr. approv. Apr. 4, 1907, **07**, 826.

VERMILION (Bayou) **R.**, D. O. Broussard's Crossing, La. (S.) (Vermilion Parish br.) PLANS.—Approv. Aug. 29, 1901, **02**, 584

VERMILION (Bayou) **R.**, Perry, La. (S.) (Vermilion Parish br.) PLANS.—Approv Dec. 3, 1901, **02**, 586.

VERMILION R., at Vermilion, Ohio. (S.) (New York Central Lines.) PLANS.—Rebuilding approv. Mar. 24, 1910, **10**, 1028.

VINCENT BAYOU, Slidell, La. (S.) (St. Tammany Parish br.) PLANS.—Approv. Apr. 3, 1907, **07**, 826.

W.

WABASH R., near Merom, Ind. (Sp.) **82,** 263, 2011. LEGISLATION.—Br. au. by act June 30, 1879, **82,** 263. PLANS.—Approv. of, recom. by Chief of Engineers, **82,** 2011.

WABASH R. (A.) (1, Main Street br. at La fayette; 2, Lake Erie & Western R. R. br. at Lafayette; 3, Wabash, St. Louis & Pacific R. R. br. at Attica; 4, Chicago & Great Southern R. R br. at Attica; 5, Indiana, Bloomington & Western R. R. br. at Covington, and Columbus & St. Louis R. R. br. near Lodi, Ind.) **88,** 2556. PLANS.—Maj. Miller reported all these brs. complete obstrs. to S. S. navigation at and above a medium stage of water, and recom. insertion of draw spans over the h.-w. chan. of 60′ width in the clear, **88,** 2557.

WABASH R., near Mount Carmel, Ill. (Sp.) (Evansville, Mount Carmel & Northern Ry. Co.) Au. act June 30, 1906. PLANS.—Approv. Dec. 22, 1906, **07,** 818.

WABASH R., near Mount Carmel, Ill. (Sp.) (Leonard J. Hackney and Frank L. Littleton—Evansville, Mount Carmel & Northern Ry. Co.) Au. act Apr. 15, 1910. PLANS.—Approv. May 10, 1910, **10,** 1022.

WABASH R., near Riverton, Ind. (Sp.) (Indianapolis Southern R. R. Co.) Au. act June 30, 1879. PLANS.—Reconstr. approv. Feb. 8, 1910, **10,** 1021.

WABASH R., in Vigo County, Ind. (Sp.) (Southern Indiana Ry. Co.) Au. act Apr. 7, 1904. PLANS.—Approv. Oct. 28, 1904, **05,** 720.

WABASH and **WHITE Rs.,** Ind. (A.) **88,** 2647' **90,** 341. PLANS.—List of brs. without draws and forming total obstrs. at high stages, **88,** 2648. Maj. Stickney recom. it be made optional with the br. owners whether they insert a draw and guard p. or raise their brs. enough to obtain 20′ clearance between the lower chord and h.-w. mark, **88,** 2648.

WACCAMAW R., Conway, S. C. (S.) (Conway & Seashore R. R. Co.) PLANS.—Approv. June 22, 1903, **03,** 650.

WACCAMAW R., near Conway, S. C. (Sp.) (Horry County br.) Au. act Feb. 15, 1911. PLANS.—Approv. Apr. 21, 1911, **11,** 1080, 1081.

WALLACE CREEK, S. C. (S.) (Colleton County br.) PLANS.—Approv. Aug. 8, 1902, **03,** 645.

WALLUSKI R., Oreg. (Sp., etc.) (Clatsop County br.) LEGISLATION.—County au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Oregon. PLANS.—Modified plans approv. Oct. 26, 1891, **92,** 400.

WAPPINGER CREEK, N. Y. (O.) (New York Central & Hudson River R. R. Co.) PLANS.—Alterations to be completed on or before 6 months from Oct. 22, 1906, **07,** 828.

WAPPINGER CREEK, New Hamburg, N. Y. (S.) (New York Central & Hudson River R. R. Co.) PLANS.—Approv. Feb. 7, 1907, **07,** 825.

WAPPOO CREEK, S. C. (O.) (Klaren Br. Co.) PLANS.—Alterations to be made within 4 months from Mar. 30, 1910, **10,** 1032.

WAPPOO CUT, St. Andrews Parish to James Isld., S. C. (S.) (Wappoo Br. Co.) PLANS.—Approv. Sept. 22, 1898, after change made in location, **99,** 620.

WARDS CREEK, Carteret County, N. C. (County br.) PLANS.—Approv. July 19, 1910. **11,** 1082.

WAREHAM R., at Narrows, Wareham, Mass. (S.) (New Bedford & Onset Street Ry. Co.) PLANS.—Approv. July 10, 1901, **02,** 583.

WARM SPRINGS CREEK and **COYOTE CREEK,** near Alviso, Cal. (S.) (Southern Pacific Co.) PLANS.—Rebuilding approv. Aug. 17, 1903, **04,** 714. Substitute plans approv. Sept. 8, 1904, **05,** 724.

WARREN R., R. I. (Sp.) (Warren town br.) Au. act Apr. 15, 1910. PLANS.—Approv. May 24, 1910, **10,** 1022.

WARRIOR R., Fosters Ferry, Ala. (S.) (Tuscaloosa County br.) PLANS.—Approv. July 19, 1899, **99,** 623.

WARRIOR R., Tuscaloosa County, Ala. (Sp., etc.) (Mobile & Ohio R. R. Co.) **97,** 530. LEGISLATION.—Company au. to constr. br. by act June 11, 1896, **97,** 530. PLANS.—Approv. Aug. 19, 1897, **97,** 530.

WARRIOR R., Tuscaloosa to Northport, Ala. (O.) (Tuscaloosa County br.) PLANS.—Requiring a draw to be placed in br. between p. No. 1 and p. No. 2 to give a clear opening of 90′; to be completed on or before Dec. 1, 1895, **96,** 483.

WASHINGTON, D. C.—Cabin John Br. (st. br.). (Br. No. 4.) CONTRACTS.—**1872.** Lee Palmer & Co., coping (contract annulled). J. Muddaman, coping (contract annulled). R. A. Shinn & Co., 6,950 c. f. coping. **72,** 1022, 1023. ENGINEERS.—In charge: Maj. G. H. Elliot, 1871. **R., 71,** 949. Maj. O. E. Babcock, 1872-76. **Rs., 72,** 1022; **73,** 1166; (Col.) **76,** ii, 693. Col. G. H. Elliot, 1892-94. **Rs., 92,** 3360; **93,** 4290, 4298; **94,** 3203. Maj. J. G. D. Knight, 1895. **R., 95,** 4105. Capt. D. D. Gaillard, 1896. **R., 96,** 3914. Assistant: T. B. Samo. **R., 71,** 955. OPERATIONS.—**1873.** Cutting and setting st. for repairs to br., 73, 1167. 1875-76. Pavements repaired, 76, ii, 693. 1892-93. Roadway repaired, 93, 4290. 1894-95. Br. repaired with vitrified brick, 95, 4105. 1895-96. Parapet walls repaired, 96, 3914. PROJECTS.—Maj. Elliot submitted, 1871, plans for repairs, 71, 949.

WASHINGTON, D. C.—College Pond. (Iron.) (Br. No. 5.) In charge: Maj. N. Michler, 1867-69. Col. O. E. Babcock, 1873-76. Rs., 73, 1166; 74, ii, 409; 75, ii, 815; 76, ii, 694. Lt. Col. T. L. Casey, 1880. R., 80, 2345. Lt. Col. A. M. Miller, 1900. R., 00, 5196. Assistant: T. B. Samo. Rs., 67, 550; 69, 506. OPERATIONS.—1867. Br. is in a good condition, 67, 550. 1868-00. Br. painted, 69, 506; 80, 2345; 00, 5196.

WASHINGTON, D. C.—Griffith Park Br. (Br. No. 3.) CONTRACTS.—1872. R. A. Shinn & Co., 3,106 c. f. coping, 72, 1023. In charge: Maj. G. H. Elliot, 1871. R., 71, 949. Maj. O. E. Babcock, 1872-76. Rs., 72, 1023; (Col.) 76, ii, 690. Col. G. H. Elliot, 1892-94. Rs., 92, 3361; 93, 4290, 4298; 94, 3203. Maj. J. G. D. Knight, 1894. R., 95, 4105. Capt. D. D. Gaillard, 1896. R., 96, 3914. Assistant: T. B. Samo. R., 71, 955. OPERATIONS.—1876. Pavements repaired, 76, ii, 693. 1893-94. Br. repaired with vitrified bricks, 94, 4105. 1895-96. Parapet walls repaired, 96, 3914.

WASHINGTON, D. C.—Receiving reservoir (Delecarlia). (Wooden br. over waste chan.) In charge: Lt. Col. T. L. Casey, 1880-81. Rs., 80, 2348; 81, 2703. Col. G. H. Elliot, 1892-94. Rs., 92, 3360; 93, 4290, 4299; 94, 3203. Maj. J. G. D. Knight, 1895. R., 95, 4105. Capt. D. D. Gaillard, 1896. R., 96, 3914. Capt. T. A. Bingham, 1898. R., 98, 3630. Lt. Col. A. M. Miller, 1899-1900. Rs., 99, 3785; 00, 5196. OPERATIONS.—1880-81. Br. rebuilt, 81, 2704. 1892-95. Br. repaired, 93, 4290; 95, 4105. 1895-96. Extensive repairs made, 96, 3914. 1897-98. Floor repaired, 98, 3630. 1898-99. Minor repairs made, 99, 3785. 1899-00. Floor renewed, 00, 5196. PROJECTS.—Description of br. built in 1863. In a dangerous condition. 80, 2348. Erected in 1863, rebuilt in 1881, 81, 2704. Col. Elliot est., 1893, $18,000 to replace this br. with a masonry br., 93, 4299.

WASHINGTON AQUEDUCT, brs. on. CONTRACTS.—1873. T. Harvey, cut st. parapets and coping for brs. Nos. 1, 2, and 3, 73, 1167. In charge: Maj. N. Michler, 1867-70. Maj. G. H. Elliot, 1871. Maj. O. E. Babcock, 1872-73. Rs., 72, 1022; 73, 1167. Assistant: T. B. Samo. Rs., 67, 549; 68, 908; 69, 505; 70, 524; 71, 955. OPERATIONS.—1866-67. Brs. Nos. 1, 2, 3, and 5 are unfinished, 67, 549; 68, 908; 69, 505; 70, 524. 1872-73. Brs. Nos. 1, 2, and 3 completed, 74, ii, 399. PROJECTS.—Importance of these brs. can not be overest. Rapidly deteriorating, and if winters continue as cold and as changeable, their usefulness for aqueduct purposes will become seriously impaired. 67, 549.

WATEREE R., S. C. (A.) (South Carolina R. R. and Wilmington, Columbia & Augusta R. R.) LEGISLATION.—Use of South Carolina R. R. br. without draw au. by State acts of 1853 and 1858, 88, 2548. PLANS.—Capt. Bixby reported both brs. an obstr. to navigation, and recom. insertion of suitable draw spans 60′ in the clear be required, 88, 2548.

WATEREE R., near Kingsville, S. C. (S.) (Southern Ry. Co.) PLANS.—Reconstr. approv. Oct. 16, 1902, 03, 646.

WATTUSKI R., Oreg. (Dr.) 02, 581.

WEAKFISH CREEK, near Corson Inlet, N. J. (O.) (West Jersey & Seashore R. R. Co.) PLANS.—Alterations to be completed within 7 months from July 23, 1909; subsequently extended to Apr. 10, 1910, 10, 1031.

WELSHMANS CREEK, Md. (See Jones Creek.)

WEST B., Galveston Isld. to Virginia Pt., Tex. (Sp., etc.) (Galveston County br.) LEGISLATION.—County au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Texas. PLANS.—Approv. July 20, 1892, 92, 407.

WEST FORK R., near Fairmont, W. Va. (S.) (Buckhannon & Northern R. R. Co.) PLANS.—Approv. Jan. 25, 1904, 04, 716.

WEST FORK R., at Lumberport, W. Va. (S.) (West Virginia Short Line R. R. Co.) PLANS.—Approv. Mar. 12, 1910, 10, 1028.

WEST FORK R., near mouth of Tavebaugh Creek, W. Va. (S.) (Monongahela River R. R. Co.) PLANS.—Br. to replace existing str. approv. May 23, 1910, 10, 1030.

WEST GALVESTON B., Galveston, Tex. (S.) (Galveston County br.) PLANS.—Approv. Sept. 30, 1907, 08, 870. Modified plans approv. June 23, 1909, 09, 918.

WEST PEARL R., Miss. (S.) (New Orleans & Northeastern R. R. Co.) PLANS.—Rebuilding approv. Mar. 16, 1906, 06, 805.

WEST R. (See Stony Creek, Conn.)

WEST R., Kimberly Avenue, New Haven, Conn. (O.) (New Haven and Orange br.) PLANS.—Specified alterations required on or before Oct. 14, 1900, 00, 702. Alterations to be completed within 1 year from Apr. 11, 1903, 03, 651.

WEST R., New Haven, Conn. (S.) (New York, New Haven & Hartford R. R. Co.) PLANS.—Reconstr. approv. Nov. 5, 1906, 07, 823.

WEST R., NE. Branch, Kimberly Avenue, New Haven, Conn. (S.) (City br.) PLANS.—Reconstr. approv. July 25, 1905, 06, 801.

WEST THOROFARE, N. J. (S.) (Long Beach Turnpike Co.) PLANS.—Approv. Mar. 14, 1912, 12, 1306.

WEST TWIN R., at Two Rivers, Wis. (S.) (Chicago & North Western Ry. Co.) PLANS.—Approv. May 5, 1904, 04, 718.

WEST VALLEY (Skamokawa) CREEK, Skamokawa, Wash. (S.) (Wahkiakum County br.) PLANS.—Approv. Mar. 25, 1904, 04, 717.

WESTHAMPTON BEACH, Suffolk County, N. Y. (Across chan. separating ocean beach from mainland, Long Island, N. Y.) (S.) (West Bay Co.) PLANS.—Reconstr. approv. Jan. 12, 1912, **12,** 1304.

WESTPORT R., E. Branch, Westport Pt., Mass. (S.) (Bristol County br.) PLANS.—Approv. July 5, 1894, **94,** 429.

WEWEANITITT R., Wareham and Marion, Mass. (S.) (State brs.) PLANS.—Reconstr. approv. June 14, 1901, **01,** 667.

WEYMOUTH BACK R., at Lincoln Street, Hingham, Mass. (O.) (Brs. of Old Colony Street Ry. Co., the city of Quincy, and the towns of Weymouth and Hingham.) PLANS.—Alterations of the 2 brs. to be completed by June 30, 1911, **10,** 1032.

WEYMOUTH BACK R., between Weymouth and Hingham, Mass. (S.) (State br.) PLANS.—Reconstr. of existing br. approv. Jan. 17, 1912, **12,** 1304.

WEYMOUTH FORE R., between Quincy and Weymouth, Mass. (S.) (Norfolk County br.) PLANS.—Approv. Aug. 22, 1901; modified plans approv. Nov. 16, 1901, **02,** 584. Reconstr. approv. June 20, 1911, **11,** 1090.

WHATCOM (I and J Street Waterway), Wash. (S.) (Seattle & Montana R. R. Co.) PLANS.—Rebuilding approv. Aug. 21, 1902, **03,** 645, 646.

WHATCOM (I and J Street Waterway), Wash. (S.) (Bellingham City br.) PLANS.—Approv. Feb. 13, 1904, **04,** 716, 717.

WHATCOM CREEK WATERWAY, at New Whatcom, Wash. (S.) (Seattle & Montana R. R. Co.) PLANS.—Rebuilding approv. Nov. 27, 1900, **01,** 663. Approv. Nov. 5, 1902, **03,** 647.

WHATCOM CREEK and SANALICUM CREEK WATERWAYS, Bellingham B., Wash. (S.) (H. H. Taylor, trustee for Bellingham & British Columbia Ry. Co.) PLANS.—Approv. Feb. 6, 1909, **09,** 917.

WHEELING CREEK, at Wheeling, W. Va. (S.) (Pennsylvania Lines west of Pittsburgh.) PLANS.—Br. to replace existing str. approv. Mar. 25, 1910, **10,** 1028.

WHITE OAK B., Houston, Tex. (S.) (Missouri, Kansas & Texas R. R. Co.) PLANS.—Approv. Nov. 28, 1892, **93,** 466.

WHITE R. and tributaries. (Dr.) **07,** 815.

WHITE R., Ark. (Sp.) (White River Ry. Co.) Au. act May 3, 1902. PLANS.—Approv. Feb. 13, 1903, **03,** 644.

WHITE R., between Arkansas and Desha Counties, Ark. (Sp.) (Memphis, Helena & Louisiana Ry. Co.) Au. act Feb. 24, 1902. PLANS.—Approv. Aug. 14, 1902, **03,** 643.

WHITE R., near Augusta, Ark. (Sp.) (St. Louis, Iron Mountain & Southern Ry. Co.) Au. act Feb. 19, 1910. PLANS.—Reconstr. approv. Mar. 15, 1910, **10,** 1021.

WHITE R., near Negro Hill, Ark. (S. and Sp.) (Missouri & North Arkansas R. R. Co.) PLANS.—Approv. Mar. 13, 1908, **08,** 872.

WHITE R., Newport, Ark. (Sp.) (Newport Br., Belt & Terminal Ry. Co.) Au. act June 21, 1902. PLANS.—Approv. July 8, 1902, **03,** 642.

WHITE R., Ind. (See Wabash R.)

WHITE R., near Deckers Station, and above the mouth of the W. Fork, Ind. (A.) (Evansville & Terre Haute R. R. Co. and the Evansville & Indianapolis R. R. Co.) PLANS.—Description of the brs. Draw should be placed in the Evansville & Indianapolis br., and the location of the draw in Evansville & Terre Haute br. changed. **88,** 2558.

WHITE R., Ind. (O.) (Evansville & Terre Haute R. R. Co. and Indianapolis R. R. Co.) PLANS.—Alterations for the 2 brs. required by Jan. 1, 1890, **89,** 376.

WHITE R., near mouth of Conger Creek, Ind. (S.) (Chicago, Indianapolis & Evansville R. R. Co.) PLANS.—Approv. Oct. 23, 1907, **08,** 871.

WHITE R., Indianapolis, Ind. (S.) (Cleveland, Cincinnati, Chicago & St. Louis Ry. Co.) PLANS.—Approv. Apr. 8, 1902, **02,** 588.

WHITE R., near Black R. Junction, Wash. (S.) (Seattle-Tacoma Interurban Ry.) PLANS.—Approv. Aug. 13, 1901, **02,** 584.

WHITE R., near Kent, Wash. (S.) (Seattle-Tacoma Interurban Ry.) PLANS.—Approv. Aug. 13, 1901, **02,** 584.

WHITE R., near town of Kent, King County, Wash. (S.) (King County br.) PLANS.—Approv. July 5, 1904, **05,** 722.

WHITE R., just s. of Kent, Wash. (S.) (King County br.) PLANS.—Approv. Apr. 26, 1911, **11,** 1088.

WHITE R., King County, Wash. (S.) (King County br.) PLANS.—Approv. Apr. 2, 1906, **06,** 805.

WHITE R., King County, Wash. (S.) (State br.) PLANS.—Approv. Sept. 8, 1910, **11,** 1083.

WHITE R., near Orillia, Wash. (S.) (King County br.) PLANS.—Approv. June 10, 1899, **99,** 623.

WHITE R., Orillia, Wash (.S.) (King County br.) PLANS.—Approv. Aug. 15, 1908, **09,** 914.

WHITE SALMON R., Wash. (S.) (Portland & Seattle Ry. Co.) PLANS.—Approv. Feb. 9, 1907, **07,** 825.

WILLAMETTE R., Albany, Oreg. (Sp., etc.) (City br.) LEGISLATION.—Company au. to constr. br. by act Dec. 26, 1890. PLANS.—Modified plans approv. Dec. 23, 1891, **92,** 402.

WILLAMETTE R., Albany, Oreg. (Sp.) (Oregon Central & Eastern R. R. Co.) LEGISLATION.—Company au. to constr. br. by act June 24, 1884. PLANS.—Alteration plans, reducing length of the fixed spans, approv. Sept. 30, 1895, **96,** 422.

WILLAMETTE R., at Corvallis, Oreg. (S.) (Benton County br.) PLANS.—Approv. Feb. 10, 1910, **10,** 1027.

WILLAMETTE R., Harrison Street, Corvallis, Oreg. (S.) (Benton County br.) PLANS.—

Approv. Feb. 10, 1910, and modified plans changing location to Van Buren Street approv. Apr. 1, 1911, **11**, 1088.

WILLAMETTE R., Harrisburg, Oreg. (S.) (Southern Pacific Co.) PLANS.—Rebuilding approv. June 14, 1905, **05**, 728.

WILLAMETTE R., Oreg. (Dr.) **08**, 865; **11**, 1078.

WILLAMETTE R., 1 m. above Harrisburg, Oreg. (S.) (Oregon Electric Ry. Co.) PLANS.—Approv. Feb. 14, 1912, **12**, 1305.

WILLAMETTE R., Oswego, Oreg. (S.) (Beaverton & Willsburg R. R. Co.) PLANS.—Approv. Apr. 5, 1907, **07**, 826.

WILLAMETTE R., Portland, Oreg. (Sp.) COMMERCE.—Requirements of, on Willamette R., **82**, 2046, 2047, 2051, 2056, 2083, 2091. ENGINEERS.—Chief of Engineers. **Rs., 73**, 63, 592; **82**, 263; **85**, 292; **87**, 339. Boards convened at Portland, Oreg., in Nov., 1872, and reported in favor of the plan, with certain requirements of location. **R., 73**, 593. Approv. by Chief of Engineers and Sec. of War, Jan. 2, 1873, **73**, 593. (Lt. Col. Alexander, Majs. Stewart, Mendell, and Robert, and Lt. Weeden.) **R., 87**, 2663-2669. LEGISLATION.—Br. au. by act Feb. 2, 1870, **73**, 592. State legislation, 1878, au. constr. of br., **82**, 2043, 2044; **87**, 2669. PLANS.—Described, **73**, 594. Submitted by city of Portland, Oreg., referred to BE., **73**, 592. General description of br. proposed, **82**, 2052, 2080. Opposition to constr. of brs. at location proposed, **82**, 2044, 2046, 2058, 2068. Constr. of br. commenced in 1880, **82**, 2050. Width of spans considered inadequate and location of br. improper, **82**, 2064. Action of Dept. of Justice toward protecting the rights of the U. S., **82**, 2067, 2072. Injunction granted against constr. of br. by U. S. circuit court, 1881, **82**, 2082, 2094. Petition in 1885 for constr. of br., **85**, 1918.

WILLAMETTE R., Burnside and Knight-Quinby Streets, Portland, Oreg. (Sp., etc.) (City br.) Chief of Engineers. **R., 92**, 409. Boards. (Maj. T. H. Handbury, Capt. T. W. Symons, and Lt. H. Taylor.) LEGISLATION.—City au. to constr. brs. under act Sept. 19, 1890, sec. 7, and act of Oregon, **92**, 409. PLANS.—For 2 drawbrs.; reported adversely upon by BE. recom. for disapprov.; concurred in by Chief of Engineers; approv. Aug. 24, 1892, **92**, 409.

WILLAMETTE (Lower) R., Portland, Oreg. (A.) (North Pacific R. R. br. and wagon br.) PLANS.—Both strs. a menace to navigation; should be wholly removed, **88**, 2593.

WILLAMETTE R., Portland, Oreg. (S.) (City br.) PLANS.—Rebuilding approv. June 26, 1909, **09**, 919.

WILLAMETTE R., near Portland, Oreg. (S.) (Portland & Seattle Ry. Co.) PLANS.—Approv. June 20, 1906, **06**, 808.

WILLAMETTE R., at Adams and Oregon Streets, Portland, Oreg. (S.) (Oregon R. R. & Navigation Co.) PLANS.—Br. to replace existing str. at Holliday Avenue approv. Nov. 10, 1909, **10**, 1025.

WILLAMETTE R., at Broadway, Portland, Oreg. (S.) (City br.) PLANS.—Approv. Mar. 23, 1910, **10**, 1028.

WILLAMETTE R., between Morrison and E. Morrison Streets, Portland, Oreg. (S.) (City br.) PLANS.—Br. to replace existing str. approv. Dec. 11, 1903, **04**, 716.

WILLAMETTE R., Salem, Oreg. (Sp.) **87**, 339, 2683. LEGISLATION.—Br. au. by act July 29, 1886. PLANS.—Br. already built when plans were submitted for approv. With slight modifications the br. not a serious obstr. to navigation. **87**, 339, 2687.

WILLAMETTE R., Union Street, Salem, Oreg. (S.) (Salem Falls City & Western Ry. Co.) PLANS.—Approv. Apr. 17, 1911, **11**, 1088.

WILLAMETTE R., near Wilsonville, Oreg. (S.) (Oregon Electric Ry. Co.) PLANS.—Approv. Aug. 8, 1906, **07**, 821.

WILLAMETTE (Upper) R., Oreg. (Ferry cables across.) (A.) PLANS.—List of localities at which such obstrs. exist, **88**, 2590.

WILLAPA R., at city of Raymond, Wash. (S.) (City br.) PLANS.—Approv. Aug. 11, 1909, **10**, 1024.

WILLAPA R., S. Arm, Wash. (Sp., etc.) (United Railroads of Washington.) LEGISLATION.—Company au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Washington. PLANS.—Approv. July 7, 1892, **92**, 407.

WILLAPA R. (S. Fork), at Raymond, Wash. (S.) (Northern Ry. Co.) PLANS.—Reconstr. approv. Dec. 2, 1909, **10**, 1025.

WILLAPA R., S. Fork, Pacific County, Wash. (S.) (Pacific County br.) PLANS.—Approv. Sept. 1, 1904, **05**, 723.

WILLAPA R., above Willapa, Wash. (S.) (Eastern & Pacific Ry. Co.) PLANS.—Approv. May 9, 1910, **10**, 1029.

WILMINGTON B. (arm of), from Wilmington to San Pedro, Cal. (S.) (Los Angeles Interurban Ry. Co.) PLANS.—Trestle br. approv. May 7, 1904, **04**, 718.

WILMINGTON LAGOON SLOUGH, inner H. of San Pedro, Cal. (S.) (Kerckhoff-Cuzner Mill & Lumber Co.) PLANS.—Approv. Mar. 29, 1898, **98**, 535.

WILSON CREEK, Willapa, Wash. (S.) (Pacific County br.) PLANS.—Approv. June 28, 1907, **07**, 828.

WILTON WATERWAY, at Tacoma, Wash.; **DAY ISLAND WATERWAY,** at Tacoma, Wash.; **STEILACOOM CREEK WATERWAY,** near Steilacoom, Wash.; **5TH STREET WATERWAY,** at Steilacoom, Wash.; and **CLIFF AVENUE WATERWAY,** at Steilacoom, Wash. (S.) (Northern Pacific Ry. Co.) PLANS.—Approv. Nov. 19, 1909, **10**, 1025.

WIND R., Wash. (S.) (Portland & Seattle Ry. Co.) PLANS.—Approv. Feb. 26, 1907, **07**, 825.

WINTHROP COVE, New London, Conn. (S.) (Central Vermont Ry. Co.) PLANS.—Reconstr. approv. Nov. 23, 1903, **04,** 715.

WINTHROP COVE, Crystal Avenue, New London, Conn. (S.) (City br.) PLANS.—Rebuilding approv. Nov. 14, 1906, **07,** 823.

WINTHROP COVE, New London, Conn. (S.) (New York, New Haven & Hartford R. R. Co.) PLANS.—Reconstr. approv. Jan. 2, 1907, **07,** 824.

WISCONSIN R., Wis. (S.) (Union Br. Co.) PLANS.—Approv. Mar. 19, 1901, **01,** 665.

WISCONSIN R., Kilbourn City, Wis. (S.) (Chicago, Milwaukee & St. Paul Ry. Co.) PLANS.—Rebuilding approv. June 14, 1902, **02,** 589.

WISCONSIN R., near Lone Rock, Wis. (S.) (Lone Rock Br. Co.) PLANS.—Approv. Feb. 21, 1895, **95,** 478.

WISCONSIN R., Merrimac, Wis. (S.) (Chicago & North Western Ry. Co.) PLANS.—Reconstr. approv. Oct. 9, 1901, **02,** 585.

WISCONSIN R., Portage, Wis. (S.) (Town br.) PLANS.—Temporary br. to replace one destroyed by storm approv. Sept. 18, 1905, **06,** 802.

WISCONSIN R., Prairie du Chien, Wis. (S.) (Chicago, Burlington & Quincy Ry. Co.) PLANS.—Reconstr. approv. Feb. 3, 1903, **03,** 648.

WISCONSIN R., near Sauk City, Wis. (S.) (Chicago, Milwaukee & St. Paul Ry. Co.) PLANS.—Rebuilding approv. Oct. 5, 1909, **10,** 1024.

WISCONSIN R., Spring Green, Wis. (S.) (Spring Green, Wyoming & Wisconsin River Wagon Br. Co.) PLANS.—Approv. Dec. 7, 1903, **04,** 716.

WISCONSIN R., Wyoming and Spring Green, Wis. (S.) (Town br.) PLANS.—Approv. May 23, 1906, **06,** 807.

WISHKA R., Wash. (S.) (United Railroads of Washington.) PLANS.—Approv. Oct. 2, 1897, **98,** 533.

WISHKA R., Heron Street, Aberdeen, Wash. (S.) (City br.) PLANS.—Approv. Nov. 29, 1905, **06,** 803.

WISHKA R., at Young Street, North Aberdeen, Wash. (S.) (City br.) PLANS.—Approv. Jan. 22, 1910, **10,** 1026; and plans for new br. at Cleveland and Lafayette Streets, in lieu of first approv., approv. Feb. 2, 1911, **11,** 1086. Latter instrument canceled May 25, 1911, and br. at Young Street approv., **11,** 1089.

WISHKA R., Chehalis County, Wash., in sec. 15, T. 18 N., R. 9 W., Willamette meridian. (S.) (Chehalis County br.) PLANS.—Approv. Feb. 8, 1910, **10,** 1027.

WISHKA R. (See Hoquiam R.)

WITHLACOOCHEE R., Dunnellon, Fla. (S. and A.) (Silver Spring, Ocala & Gulf Ry. Co.) **89,** 2797; **94,** 429; **95,** 478. PLANS.—No proper draw span; very little navigation, **89,** 2797. Plans for new br. approv. June 14, 1894, **94,** 429. Modified plans submitted Feb. 6, 1895; approv. Feb. 23, 1895, **95,** 478.

WITHLACOOCHEE R., Dunnellon, Fla. (S.) (Br. of Marion and Citrus Counties.) PLANS.—Approv. Nov. 25, 1903, **04,** 715.

WITHLACOOCHEE R., near S. Dunnellon, Fla. (S.) (Standard & Hernando R. R. Co.) PLANS.—Approv. June 3, 1904, **04,** 719.

WITHLACOOCHEE R., Istachatta, Fla. (S.) (Hernando County br.) PLANS.—Approv. Oct. 8, 1909, **09,** 915.

WITHLACOOCHEE R., in Marion and Citrus Counties, Fla. (S.) (Tampa Northern R. R. Co.) PLANS.—Approv. Mar. 15, 1910, **10,** 1028.

WITHLACOOCHEE R. and **BLUE RUN** (Wekiva R.), near Dunnellon, Fla. (S.) (Seaboard Air Line Ry. Co.) PLANS.—Approv. Mar. 15, 1910, **10,** 1028.

WITHLACOOCHEE and **PEACE RS.** (A.) (Florida Southern, the South Florida, and the Florida R. R. & Navigation Co.) **88,** 2630. PLANS.—Brs. would have to be provided with draws if imp. be undertaken, **88,** 2631.

WOLF R., Gills Landing, Wis. (S.) (Wisconsin Central R. R. Co.) PLANS.—For new br. approv. Dec. 7, 1893, **94,** 427. Modified plans approv. Feb. 5, 1895, **95,** 477.

WOLF R., at Hortonville, Wis. (S.) (Outagamie County br.) PLANS.—Reconstr. approv. Oct. 27, 1909, **10,** 1025.

WOLF R., Matteson, Wis. (S.) (Town br.) PLANS.—Approv. Sept. 13, 1905, **06,** 802.

WOLF R., near Memphis, Tenn. (S.) (Illinois Central R. R. Co.) PLANS.—Approv. Feb. 9, 1909, **09,** 917.

WOLF R., New London, Wis. (Sp., etc.) (Milwaukee, Lake Shore & Western Ry. Co.) LEGISLATION.—Company au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Wisconsin. PLANS.—For new br. approv. Mar. 22, 1892, **92,** 404.

WOLF R., between Shawano and Door Streets, New London, Wis. (S.) (City br.) PLANS.—Approv. May 23, 1912, **12,** 1307.

WOLF R., Northport, Mukwa, Wis. (S.) (Mukwa town br.) PLANS.—Approv. Jan. 12, 1898, **98,** 534.

WOLF R., at Rouses Ferry, Miss. (S.) (J. P. Rouse.) PLANS.—Approv. Sept. 21, 1909, **10,** 1024.

WOODBRIDGE CREEK, Perth Amboy and Woodbridge, N. J. (S.) (Middlesex County br.) PLANS.—Approv. July 12, 1901, **02,** 583.

WOODBURY CREEK. (See Schuylkill R.)

WOODBURY CREEK, near National Park, N. J. (S.) (Gloucester County br.) PLANS.—Rebuilding approv. Oct. 27, 1909, **10,** 1026.

WORTH LAKE, Palm Beach, Fla. (S.) (Jacksonville, St. Augustine & Indian River R. R. Co.) PLANS.—Approv. July 19, 1895, **95,** 479.

Y.

YALOBUSHA R., Leflore County, Miss. (Sp.) (Yazoo & Mississippi Valley R. R. Co.) LEGISLATION.—Company au. to constr. br. by act July 7, 1898. PLANS.—Approv. July 16, 1898, **98,** 532.

YALOBUSHA R., mouth of Martins Creek, Miss. (Sp.) (Grenada County br.) Au. act Feb. 12, 1901. PLANS.—Approv. Apr. 1, 1901, **01,** 660.

YAMHILL R., near Lafayette, Yamhill County, Oreg. (Sp., etc.) (Oregonian R. R. Co.) LEGISLATION.—Company au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Oregon. PLANS.—Reconstr. plan approv. Dec. 12, 1891, **92,** 402.

YAZOO R. (See Sunflower R.)

YAZOO R., Belzoni, Miss. (Sp.) (Washington County br.) Au. act Apr. 13, 1906. PLANS.—Approv. Aug. 23, 1906, **07,** 817.

YAZOO R., Greenwood, Miss. (Sp.) (Leflore County br.) LEGISLATION.—County au. to constr. br. by act Mar. 3, 1897; amending act Apr. 29, 1898. PLANS.—Approv. May 12, 1898, **98,** 531.

YAZOO R., at or near Roebuck Landing, Miss. (S.) (Leflore County br.) PLANS.—Approv. Apr. 8, 1911, **11,** 1088.

YAZOO R., Shell Bluff, Miss. (S.) (Leflore County br.) PLANS.—Approv. Oct. 20, 1910, **11,** 1084. Plans for pile protection approv. Mar. 10, 1911, **11,** 1087.

YAZOO R., Yazoo City, Miss. (S.) (Yazoo & Mississippi Valley R. R. Co.) PLANS.—Approv. Jan. 29, 1902, **02,** 586.

YELLOW MILL POND, Stratford Avenue, Bridgeport, Conn. (S.) (City br.) PLANS.—Reconstr. plan approv. Oct. 12, 1897, **98,** 533.

YELLOWSTONE R., Glendive, Mont. (Sp.) (Dawson County br.) LEGISLATION.—County au. to constr. br. by act Feb. 26, 1895, **95,** 475, and June 6, 1900. PLANS.—Approv. July 9, 1895, **95,** 475. Reconstr. approv. July 19, 1900, **01,** 659.

YELLOWSTONE R., Glendive, Mont. (Sp.) (Northern Pacific Ry. Co.) Au. act June 23, 1910. PLANS.—Approv. July 16, 1910, **11,** 1079.

YELLOWSTONE R., near Tusler, Terry, and Miles City, Mont. (Sp.) (Chicago, Milwaukee & St. Paul Ry. Co.) Au. act Apr. 2, 1906. PLANS.—Approv. Dec. 4, 1906, **07,** 817.

YORK R., Me. (Dr.) **08,** 865.

YORK R., York, Me. (Sewells Br.). (O. and A.) (Town br.) PLANS.—Alterations to be completed within 3 months from Oct. 19, 1900, **01,** 667.

YORK R., York, Me. (O.) (Town br.) PLANS.—Alterations to be completed on or before June 1, 1905, **04,** 723. Approv. Apr. 11, 1907, and supple. plans July 25, 1907, **08,** 868.

YORK R., York, Me. (S.) (York County br.) PLANS.—Approv. Apr. 11, 1907, **07,** 826.

YOUGHIOGHENY R., Boston, Pa. (S. and Sp.) (Boston Br. Co.) LEGISLATION.—Company au. to constr. br. under act July 13, 1892, sec. 3, and act of Pennsylvania. PLANS.—Approv. Aug. 15, 1892, **92,** 408.

YOUGHIOGHENY R., Fayette County, Pa. (S.) (Youghiogheny Central Ry. Co.) PLANS.—Approv. Sept. 24, 1892, **93,** 466.

YOUGHIOGHENY R., 5th Avenue, McKeesport, Pa. (S.) (5th Avenue & High Street Br. Co.) PLANS.—Approv. July 31, 1895, **95,** 479.

YOUGHIOGHENY R., between McKeesport and Reynoldton, Pa. (S.) (Pittsburgh & Lake Erie R. R. Co.) PLANS.—Reconstr. plans approv. Apr. 29, 1898, **98,** 535.

YOUGHIOGHENY R., McKeesport, Pa. (S. and Sp.) (Port View Br. Co.) LEGISLATION.—Company au. to constr. br. under act Sept. 19, 1890, sec. 7, and act of Pennsylvania. PLANS.—Approv. Feb. 26, 1891, **91,** 431.

YOUGHIOGHENY R., McKeesport, Pa. (S.) (McKeesport & Port Vue Br. Co.) PLANS.—Approv. May 16, 1906, **06,** 806.

YOUGHIOGHENY R., Sutersville, Pa. (S.) (Allegheny & Westmoreland Br. Co.) PLANS.—Approv. Dec. 30, 1895, for a suspension br., **96,** 425. A truss br. was built, for which plans were approv. Apr. 13, 1897, **97,** 533.

YOUGHIOGHENY R., West Newton, Pa. (S.) (Westmoreland County br.) PLANS.—Rebuilding approv. May 18, 1905, **05,** 727.

YOUNGS B., Astoria, Oreg. (S.) (Clatsop County br.) PLANS.—Modified plans approv. Aug. 16, 1898, **98,** 537.

YOUNGS B., Oreg. (S.) (Astoria & Columbia River R. R. Co., successors to the Sea Shore Road Co.) PLANS.—Approv. Mar. 14, 1894, **94,** 428. Sea Shore Road Co., having relinquished its right to constr. this br., plans submitted by the Astoria & Columbia River R. R. Co. were approv. Nov. 18, 1895, **96,** 425.

YOUNGS B., Oreg. (Dr.) **02,** 581.

SPECIAL SUBJECTS.

REPORTS, CHIEF OF ENGINEERS, U. S. ARMY, 1866-1912.

SECTION 2.—SUPERVISION OF STRUCTURES OTHER THAN BRIDGES IN CONNECTION WITH NAVIGABLE WATERS.

"Pursuant to the provisions of sections 9 and 10 of the river and harbor act of March 3, 1899, and of certain special acts of Congress, numerous applications for permission to build structures of various kinds, other than bridges (such as DAMS, WHARVES, DOLPHINS, BOOMS, WEIRS, etc.), in the navigable waters of the United States, have been examined with a view to the protection of navigation interests.

"Upon the recommendation of the Chief of Engineers, permits have been granted by the Secretary of War for the erection of a number of such structures, but specific reference is not deemed necessary except in the following cases:"

ALVISO SLOUGH AND GUADALUPE R., Cal. (Sloughs emptying into.) (Dams—2—of A. C. Kuhn.) PLANS.—Approv. Sept. 22, 1909, **10,** 1033.

BARATARIA BAYOU, near the entrance to Harvey Canal, La. (Dam of Jefferson and Plaquemine Drainage District.) PLANS.—Plans and map of location approv. June 7, 1912, **12,** 1310.

BEAR ISLAND LAKE, Minn. (See Eve Lake.)

BIRCH LAKE, Minn. (See Eve Lake.)

CASS LAKE (outlet), Minn. (Dam of J. Neils Lumber Co.) PLANS.—Consent to constr. of temporary dam given May 6, 1911, **11,** 1092.

CHARLES R., Boston, Mass. (S.) (L. and d. of Mass.) ENGINEERS.—Chief of Engineers. R., **05,** 730. PLANS.—General plans approv. May 18, 1904; detailed plans approv. Oct. 5, 1904, **05,** 730.

CHOCTAWHATCHEE R., near Newton, Ala. (Dam of Choctawhatchee Power Co.) Au. act Apr. 5, 1906. PLANS.—Approv. Apr. 2, 1907, **07,** 830.

CHOCTAWHATCHEE R., near Newton, Ala. (Sp.) (Dam of Choctawhatchee River Light & Power Co.) Au. act Mar. 10, 1908. PLANS.—Approv. Mar. 9, 1909, **09,** 921.

CLEARWATER R. (N. Fork), at Bruces Eddy, Idaho. (Dam of Clearwater Timber Co.) PLANS.—Approv. June 9, 1910, **10,** 1633.

CLEARWATER R. (Middle Fork), at Kooskia, Idaho. (Dam of E. J. Hartman et al.) PLANS.—Approv. May 10, 1910, **10,** 1033.

CLINCH R., near Agee, Tenn. (S.) (Dam of Ruben Bollinger.) PLANS.—Approv. Jan. 19, 1909, **09,** 921.

COLORADO R., mouth of Pyramid Canyon, 22 m. n. of Port Mohave, and at or near Black Pt., 20 m. n. of Ehrenberg, Ariz. (Dams of Chucawalla Development Co.) PLANS.—Au. act Feb. 15, 1911; plans approv. May 10, 1911, **11,** 1092.

COOSA R., Ga. and Ala. (Sp.) (Dam of the Alabama Power Co., at site selected for L. and D. No. 12 under U. S. proj.) Au. act Mar. 4, 1907. PLANS.—Approv. Mar. 3, 1910, **10,** 1033.

CROW WING R., in Crow Wing County, Minn. (S.) (Dam of Cuyuna Range Power Co.) PLANS.—Approv. Apr. 12, 1912, **12,** 1309.

EVE, BIRCH, M'DOUGALL, and **BEAR ISLD. LAKES,** Minn. (Dams—4—of the Fall Lake Boom Co.) PLANS.—Approv. Oct. 15, 1909, **10,** 1033.

FOX R., at Combined Locks, Wis. (Dam of Green Bay & Mississippi Canal Co.) PLANS.—Reconstr. plan approv. Apr. 19, 1911, **11,** 1092.

LAFOURCHE BAYOU, La. (L. and d. of Atchafalaya and Lafourche Basin Levee Boards of La.) Au. act June 13, 1902. PLANS.—Approv. Dec. 17, 1902, and Nov. 20, 1903. Time for removal of temporary dam and constr. of locks extended to Jan. 1, 1910. **03,** 641; **04,** 709; **07,** 830.

M'DOUGALL LAKE, Minn. (See Eve Lake, Minn.)

MERMENTAU R., La. Act Jan. 10, 1903, au. Rice Irrigation & Imp. Association, State of Louisiana, to constr. l. and d. near mouth of R. Plans, specifications, maps approv. by Sec. of War, Mar. 12, 1903. **03,** 641.

MISSISSIPPI R., Augusta, Minn. (Dam of St. Cloud Electric Power Co.) Au. act June 28, 1906. PLANS.—Approv. Feb. 2, 1907, **07,** 829.

MISSISSIPPI R., Bemidji, Minn. (Dam of Beltrami Electric Light & Power Co., successor to Kirby Thomas, E. J. Swedback, and M. A. Spooner.) Au. act Mar. 3, 1905. PLANS.—General plans approv. Mar. 2, 1906; detailed plans approv. Apr. 29, 1907, **07,** 830.

MISSISSIPPI R., Des Moines Rapids, Iowa. (Sp.) (Dam of Keokuk & Hamilton Water Power Co.) PLANS.—Approv. May 9, 1908, **08,** 875.

MISSISSIPPI R., Rock Isld. Rapids, Scott County, Iowa. (Water Power Canal of Davenport Water Power Co.) Au. act Apr. 5, 1904; amended act Feb. 5, 1907. PLANS.—Approv. June 11, 1907, **07,** 830.

MISSISSIPPI R., at Sauk Rapids, Minn. (Dam of Sauk Rapids Water Power Co.) Au. act Feb. 26, 1904; amended act Mar. 2, 1907. PLANS.—Approv. Feb. 11, 1907, **07,** 830.

MISSISSIPPI R., in Stearns and Benton Counties, Minn., above mouth of Watab R. (Sp.) (Dam of Watab Rapids Power Co.) Au. act Apr. 23, 1904. PLANS.—Approv. Apr. 6, 1905, **05,** 730.

MISSISSIPPI R., at Coon Rapids, Minn. (Dam of Great Northern Development Co.) Au. act Jan. 12, 1911. PLANS.—Approv. Sept. 20, 1911, and amended Dec. 14, 1911, by eliminating "condition No. 3," **12,** 1309.

MISSISSIPPI R., at or near the foot of Des Moines Rapids. (Dam of Keokuk & Hamilton Water Power Co.) PLANS.—Au. acts Feb. 8 1901, and Feb. 9, 1905. Plans approv. Apr. 5, 1911. **11,** 1092.

MISSISSIPPI R., in Madison County, near Royalton, Minn. (Dam of Pike Rapids Power Co.) Au. acts June 4, 1906; Mar. 7, 1907; and Mar. 4, 1911. PLANS.—Approv. July 1, 1912, **12,** 1310.

MISSOURI R., near Canyon Ferry, Mont. (Sp.) (Dam of Helena Power Co., successor to Missouri River Power Co.) PLANS.—Approv. Oct. 19, 1905, **06,** 810.

MISSOURI R., in vicinity of Buck Rapids, Mont. (Dam of Capital City Imp. Co.) Au. act Apr. 12, 1906. PLANS.—Approv. Aug. 17, 1906, **07,** 829.

MISSOURI R., Ox Bow Bend, Mont. (Sp.) (Dam of the Ox Bow Power Co.) Au. act Apr. 28, 1904. PLANS.—Approv. Apr. 15, 1905, **05,** 730.

MISSOURI R., Wolf Creek, Mont. (Sp.) (See above.) Dam of Capital City Power Co., successor to Capital City Imp. Co.) Au. act Apr. 15, 1906. PLANS.—Approv. Apr. 14, 1908, being in lieu of plans for dam at Buck (see above) Rapids which was approv. Aug. 17, 1906, **08,** 875.

MYSTIC R., near Cradock Br., Medford, Mass. (Dam of Mass.) PLANS.—Approv. Sept. 6, 1906, **07,** 829.

NORTH R., Wash. (Dam of Loggers Boom & Driving Co.) PLANS.—Approv. Mar. 17, 1910, **10,** 1033.

RAINY LAKE R., Minn. (Sp.) (Dam of the Koochiching Co.—Rainy River Imp. Co.) Au. act May 4, 1898, and amendatory acts. PLANS.—Approv. Sept. 21, 1909, and instrument supple. thereto dated Feb. 19, 1910, **10,** 1033.

ROCK R., Carrs and Vandruffs Islds., Ill. (Dam of Samuel S. Davis.) Au. act May 1, 1906. PLANS.—Approv. Feb. 16, 1907, **07,** 830.

ROCK R., Grand Detour, Ill. (Sp.) (Dam of Spencer B. Newberry.) Au. Feb. 16, 1906. PLANS.—Approv. Feb. 4, 1909, **09,** 921.

ST. CROIX R., between Stillwater and Taylors Falls, Wis. and Minn. (A.) PLANS.—Booms, ps., and logs of the St. Croix Boom Co. form obstrs. to navigation for weeks, and sometimes months, of the season of navigation, **89,** 2798.

ST. CROIX R., St. Croix, Wis. (Sp.) (Dam of St. Croix Falls (Wis.) Imp. Co., and the St. Croix Falls (Minn.) Imp. Co.) PLANS.—Constr. of a dam au. act Feb. 7, 1903; approv. Sept. 16, 1904, **05,** 730.

ST. JOSEPH R., near Berrien Springs, Mich. (Dam of Berrien Springs Power & Electric Co.) Au. act Apr. 5, 1906. PLANS.—Approv. Apr. 19, 1907, **07,** 830.

ST. JOSEPH R., Mich. (Dam of City of Sturgis, Mich.) PLANS.—Constr. au. act Jan. 12, 1911; plans approv. Apr. 14, 1911, **11,** 1092.

ST. JOSEPH R., near Mottville, Mich. (Dam of Herman L. Hartenstein.) Au. act Feb. 13, 1911. PLANS.—Approv. Feb. 13, 1912, **12,** 1309.

ST. LAWRENCE R., between Adams and Les Galops Islds. (Sp.) (Dam of Dominion of Canada.) Au. act June 18, 1902. PLANS.—For constr. approv. Aug. 18, 1903; modified plans providing for an increase in height of dam approv. Oct. 10, 1904, **05,** 730.

ST. LOUIS R., below Fond du Lac, Wis. (A.) PLANS.—St. Louis Boom Co. maintains a log boom which is an obstr. to navigation, **89,** 2798.

SAVANNAH R., Gregg Shoals, S. C. (Sp.) (Dam of Savannah Power Co.) Au. act June 21, 1906, and Feb. 5, 1907. PLANS.—Approv. Aug. 8, 1907, **08,** 875.

SAVANNAH R., near Prices Isld., S. C. (Sp.) (Twin City Power Co.) Au. act Feb. 28, 1908. PLANS.—Approv. Feb. 20, 1909, **09,** 921.

SAVANNAH R., at or near mouth of Stevens Creek, between the counties of Edgefield, S. C., and Columbia, Ga. (Dam of Georgia-Carolina Power Co.) PLANS.—Approv. July 20, 1910, **11,** 1091.

SNAKE R., Idaho, Oreg., and Wash. (Dam of Burbank Power & Water Co., in vicinity of Fivemile Rapids.) PLANS.—Approv. Sept. 10, 1906; modified plans approv. Nov. 2, 1909, **10,** 1033.

SUSQUEHANNA R., near Conowingo, Md. (Susquehanna Power Co.) PLANS.—Approv. Apr. 9, 1907, **07,** 830.

TENNESSEE R., at Hales Bar, below Chattanooga, Tenn. (Dam of Chattanooga & Tennessee River Power Co.) PLANS.—Approv. Aug. 26 and Oct. 14, 1910, **11,** 1092.

WALLICUT R. (N. and S. Forks), Wash. (Dam of commissioners of diking district No. 1, Pacific County, Wash.) PLANS.—Approv. Sept. 28, 1910, **11,** 1091.

WHITE R. (E. Fork), 4 m. below Shoals, Ind. (Dam of Shoals Power Co.) PLANS.—Approv. Apr. 20, 1911, **11,** 1092.

WHITE R., near Forsyth, Taney County, Mo. (Dam of Ozark Power & Water Co.) Au. act

Feb. 4, 1911. PLANS.—Approv. Nov. 24, 1911, **12**, 1309.

WHITE R., E. Fork, Williams, Ind. (S.) (Dam of Bedford Power Co.) PLANS.—Approv. Feb. 27, 1909, **09**, 921.

WILLAMETTE SLOUGH, near Portland, Oreg. (S.) (Dam of Ruth Trust Co.) PLANS.—For str. to replace one built by the U. S. approv. May 12, 1909, **09**, 921.

WISCONSIN R., Kilbourn, Wis. (Sp.) (Dam of P. L. Spooner.) PLANS.—Approv. Feb. 7, 1906, **06**, 810.

WISCONSIN R., near Prairie du Sac, Wis. (Dam of Badger Hydro-Electric Co.) PLANS.—Approv. Aug. 4, 1909, **10**, 1032.

WISCONSIN R., near Prairie du Sac, Wis. (Dam of Wisconsin River Power Co.) PLANS.—Approv. Feb. 3, 1911, **11**, 1092; and May 11, 1912, **12**, 1309.

WITHLACOOCHEE R., Dunnellon, Fla. (Sp.) (Dam of Camp Phosphate Co.) Au. act June 13, 1902. PLANS.—Approv. Apr. 16, 1904; modified plans approv. Sept. 23, 1905, **06**, 810.

SPECIAL SUBJECTS.

REPORTS, CHIEF OF ENGINEERS, U. S. ARMY, 1866-1912.

SECTION 3.—ESTABLISHMENT OF HARBOR LINES.

Place.	Reports of Chief of Engineers.
Aberdeen, Wash. (see Chehalis.)	**93,** 462, 3472 **06,** 797 **11,** 1076
Absecon Inlet, N. J	**09,** 910
Acushnet R., Mass	**03,** 640, 820
Adams, Isld., N. Y	**02,** 579, 961
Adams Street, Troy, N. Y	**09,** 910
Alameda H., Cal. (see San Francisco):	
Estab. of H. lines on e. shore of San Francisco B., from Pt. San Pablo southward, in front of Oakland and Alameda, Cal	**94,** 424, 2505
Albany, N. Y. (see Hudson R.)	**03,** 640, 901
Albina, Oreg.:	
Willamette R	**99,** 39, 3251
Alexandria B., N. Y. (see St. Lawrence)	**02,** 579, 2338
Alexandria, Va. (see Potomac)	**09,** 910
Alki Pt., Wash. (see Puget Sound)	**10,** 1018
Allegheny City, Pa. (see Ohio R.; Pittsburgh):	
Ohio R	**99,** 39, 2449
Allegheny City, Pa	**01,** 119, 2709
Allegheny R., Pa	**03,** 640, 1706 **03,** 640, 1709 **09,** 911
Allegheny R., Lock No. 2, Pa	**09,** 911
Allegheny R., Pa. (third pool), Aspinwall to Natrona, Pa	**11,** 1076
Allouez Bay. (See Superior.)	
Anacortes, Wash	**93,** 462, 3472
Anacostia R., D. C. (see Potomac R.; Washington)	**04,** 709, 1351 **11,** 1077
Annapolis H., Md	**01,** 119, 1396
Aqueduct Br., D. C	**11,** 1077
Arthur Kill, N. Y	**05,** 718, 1062 **06,** 797
Tottenville, N. Y	**06,** 796
Arthur Kill, N. J., near Tufts Pt., modification of pierhead line on w. side of Arthur Kill	**10,** 1018 **12,** 1293
Arthur Kill or Staten Isld. Sound, N. Y. and N. J., revision throughout sound from Raritan B. to Newark B	**12,** 1293
Arthur Kill, N. Y. and N. J., st. monuments	**03,** 141 **04,** 129
Arthur Kill, N. Y. and N. J.:	
Around Buckwheat Isld	**08,** 864
Arthur Kill, N. J	**01,** 118, 1279 **05,** 718, 1056, 1059
Smoking Pt	**05,** 718, 1062
Between Buckwheat Isld. and Morse Creek, N. J	**09,** 910 **10,** 1018
Ashland, Ky	**04,** 709, 2487
Ashland H., Wis	**96,** 23, 2455
Ashley R. (See Charleston.)	
Ashtabula H., Ohio	**07,** 815
Aspinwall, Pa. (see Allegheny R.)	**11,** 1076
Astoria. (See East R. and Pot Cove.)	
Astoria, Oreg. (see Columbia R.; Youngs Bay)	**04,** 709, 3577
Astoria H., Oreg	**91,** 427, 3387
Astoria H., Oreg., near	**96,** 23, 3322
Atlantic Basin, N. Y	**02,** 579, 983
Atlantic City, N. J	**09,** 910
Atlantic City Br., Norfolk, Va	**03,** 640, 1089
Back Cove, Portland, Me	**01,** 118, 1027
Ballard, Wash	**93,** 462, 3472
Puget Sound	**95,** 21, 473, 3543
Baltimore H., Md.:	
Curtis B	**90,** 40, 1697
Sparrows Pt. (Patapsco R.)	**99,** 39, 1410 **00,** 40, 1693, 1697
Sparrows Pt., Md	**03,** 640, 1033
Curtis B., s. side	**09,** 910
Baltimore H., Md., modification of lines in Curtis B. and Patapsco R	**11,** 1076
Bangor H., Me	**01,** 118, 1022
Bath, Me., Kennebec R	**91,** 424, 622
Battery, New York, N. Y	**04,** 709, 1127
Bayonne. (See New York.)	
Belle H., Jamaica B., N. Y	**06,** 796
Bellingham, Wash. (see Squalicum)	**10,** 1017
Bellingham B., Wash	**92,** 399, 2794
Bellingham B., Wash., modification	**12,** 1293
Bellingham H., Wash., at I and J Streets	**07,** 815
Benicia. (See San Francisco.)	
Bergen Neck. (See Jersey Flats; New York.)	
Berrien Isld., N. Y. (see East R.; New York.)	**03,** 640, 891
Big Stony Islds., N. Y. (see Hudson R.)	**07,** 815
Black R. (See Port Huron.)	
Black R., Mich. (see South Haven H.)	**10,** 1018
Black Rock H., N. Y. (see Buffalo.)	**01,** 119, 3349
Blaine, Wash	**93,** 462, 3472
Bloomers. (See Hudson R., N. Y.)	
Borough of Brooklyn, N. Y	**11,** 1077
Borough of Queens, N. Y	**11,** 1077
Boston, Mass. (see Cambridge; Chelsea; Jeffries Pt	**89,** 368, 601 **97,** 23, 881 **02,** 579, 887 **04,** 709, 899 **05,** 718, 836 **06,** 796
Charles R	**90,** 332, 537 **91,** 424, 688 **99,** 39, 1098 **00,** 40, 1225
Extension of p. at Marine Park beyond estab. H. lines, Dorchester Pt., e. end of South Boston	**90,** 332, 546
Mystic R., with its tributaries, and Chelsea Creek	**90,** 332, 539

Place.	Reports of Chief of Engineers.
Boston, Mass.—Continued.	
N. side of the "reserved chan.," n. side of South Boston Flats, and around Castle Isld	**91**, 424, 690
Extension of solid filling beyond the estab. bulkhead lines at Simpson's Dry Dock No. 1, Boston H	**90**, 332, 547
Jefferies Pt	**11**, 1076, 1077
Bowery B., N. Y. (see East R.; New York)	**02**, 579, 964 **06**, 796
Bremerton, Wash. (see Port Orchard)	**10**, 1017
Bridgeport, Conn	**97**, 23, 988 **99**, 39, 1193 **93**, 461, 998
Bridgeport H., Conn	**07**, 814
Brilliant Pumping Station, Pa	**09**, 911
Bristol, Pa. (see Delaware R.)	**11**, 1077
Brooklyn. (See Borough of: New York; East R.; Newtown Cr.)	
Brooklyn, N. Y. (see New York):	
East R	**98**, 34, 1028
Brooklyn, N. Y. (see Atlantic Basin)	**02**, 579, 983 **03**, 640, 898 **07**, 814
Red Hook Pt	**09**, 910
Bronx Kills. (See New York.)	
Bronx R., N. Y. (see East R.)	**01**, 118, 1266
Bronx R. (mouth), N. Y	**10**, 1018
Bronx R., between New Westchester br. and the New York, New Haven & Hartford R. R. br., in front of property of P. J. Heany Co	**12**, 1293
Bronx R., N. Y., lower part	**12**, 1293
Brother Island. (See East R.)	
Brownsville, Pa. (see Monongahela R.)	**07**, 815 **09**, 911
Bruno Island. (See San Francisco.)	
Brunot Isld., Pa. (see Ohio R.)	**07**, 815
Brunswick, Ga	**89**, 867, 1292
Brunswick H., Ga	**06**, 797
Bucksport, Cal. (see Humboldt Bay)	**06**, 797
Buckwheat Isld., N. J. (see Arthur Kill)	**08**, 864 **09**, 910
Buffalo H., N. Y.:	
Niagara R. (see Erie)	**95**, 21, 472, 3180 **99**, 39, 3123
Outer H., including West Seneca	**95**, 21, 472, 3176, 3180 **00**, 40, 4156
Stony Pt	**04**, 709, 3316
Buffalo, N. Y., Erie Basin and Black Rock H	**01**, 119, 3349
Burden Iron Works, Troy, N. Y	**09**, 910
Bushwick Cr. (See New York.)	
Buttermilk Chan., N. Y., Atlantic Basin, Brooklyn	**02**, 579, 983
Byram R., N. Y	**01**, 118, 1261
Calumet H., Ill	**99**, 39, 2891
Cambridge, Mass. (see Boston)	**97**, 23, 881 **99**, 39, 1100 **00**, 40, 1225 **06**, 796
Charles R	**97**, 23, 881 **00**, 40, 1225 **04**, 709, 899 **05**, 718, 836 **06**, 796
Camden, N. J. (see Philadelphia)	**11**, 1077
Canal Waterway, Wash	**10**, 1018
Cape Fear R., N. C	**01**, 119, 1572
Wilmington, N. C	**06**, 797
Carquinez Straits (see San Francisco)	
Carters Creek, Va	**05**, 718, 1182
Castle Island (see Boston)	
Castro Rocks, Cal. (see San Francisco)	**09**, 911
Charles R., Cambridge, Boston, Mass. (see Boston; Cambridge)	**04**, 709, 899 **05**, 718, 836 **06**, 796
Charleston H., S. C	**97**, 23, 1487
Ashley R	**97**, 23, 1487
Cooper R	**97**, 23, 1487
Charleston, Wash. (see Port Orchard)	**10**, 1017
Cheesequakes Cr. (See New York.)	
Chehalis and Wishkah Rs., Aberdeen, Wash	**06**, 797
Chehalis R., at Aberdeen, Wash., modification	**11**, 1076
Chelsea Creek (see Boston H.) Mass., modification of line in left bank	**11**, 1076
Chesapeake Cr. (See New York.)	
Chester, Pa. (see Delaware R.)	**06**, 797
Chicago H., Ill	**91**, 426, 2661 **06**, 797
Chicago R., N. Branch, Ill	**02**, 579, 2110
China Basin, Cal	**03**, 640, 2202 **10**, 1018
Christiana R., Del., Wilmington, Del. (see Delaware R.)	**03**, 640, 981 **11**, 1076
Cincinnati, Ohio	**96**, 23, 2126
City Pt. (See Richmond.)	
Cleveland H., Ohio	**95**, 21, 472, 3127 **96**, 23, 3094 **99**, 39, 3080
W. Basin	**11**, 1076
College Pt., N. Y. (see East R.)	**01**, 119, 1305
Columbia R., Astoria, Oreg	**04**, 709, 3577
Commencement B., Wash	**02**, 579, 2432
Communipaw. (See New York.)	
Compton Cr. (See Sandy Hook.)	
Canonicut Cr. (See Jamestown.)	
Coney Isld., N. Y. (see New York; Sheepshead Bay)	**04**, 709, 1110 **11**, 1077
Conners Pt., Minn. and Wis. (see Duluth)	**11**, 1076
Constable Pt. (See Jersey Flats; New York.)	
Cooper Pt., N. J. (see Delaware R.)	**11**, 1077
Cooper R. (See Charleston.)	
Coos B., Oreg	**01**, 119, 3544
Coos B. H., Oreg	**06**, 797
Cordova B., Alaska	**10**, 1017 **11**, 1076
Coronado, Cal	**90**, 334, 2904
Cosmopolis, Wash	**93**, 462, 3472
Crisfield, Md.:	
Annemessex R	**99**, 39, 1399
Curtis B., Md. (see Baltimore)	**09**, 910 **11**, 1076
Dam No. 3, Ohio R., Pa	**04**, 709, 2554
Davenport H., Iowa	**98**, 34, 1805
Davis Isld. Dam, Pa. (see Pittsburgh)	**04**, 709, 2554
Deadmans Isld., Cal	**11**, 1077
Delaware R., Del.:	
Between Edgemoor and Christiana Rs	**03**, 640, 981
League Isld	**02**, 579, 1041
Chester R	**06**, 797
Delaware and Schuylkill Rs., Philadelphia, Pa	**09**, 910
At Philadelphia, Pa. (see Philadelphia)	**10**, 1018
Delaware R., Cooper Pt., near Camden, N. J., extension of lines.	**11**, 1077
Delaware R., Philadelphia to Bristol, lines on right bank from upstream end of lines at Philadelphia	**11**, 1077
Delaware R., at Trenton, N. J	**11**, 1077
Detroit, Mich	**93**, 462, 3039
Detroit R., Mich	**96**, 23, 2900 **05**, 718, 2296
District of Columbia. (See Firth-Sterling Co.)	
Dog Isld., St. Georges Sound, Fla	**00**, 40, 2158
Dorchester Pt. (See Boston.)	
Duluth H., Minn	**97**, 23, 2647 **00**, 40, 3642 **03**, 640, 1828 **05**, 718, 2011

Place.	Reports of Chief of Engineers.
Duluth, Minn., St. Louis B., Superior B., and adjacent waters, Minn. and Wis.	91, 426, 2515
Duluth-Superior H., Minn. and Wis., front of Minnesota Pt.	09, 911
Duluth-Superior H. (Howards B.), vicinity of Conners Pt., Minn. and Wis.	11, 1076
Dutch Kills. (See New York.)	
Duwamish Head, Wash. (see Puget Sound)	10, 1018
Eagle H., Wash.	07, 815
East Chester and Givans Creek, N. Y., pierhead and bulkhead lines	12, 1293
East Liverpool, Ohio. (see Ohio R.)	11, 1077
East R., N. Y. (see Long Island City; New York; Pot Cove; Rikers Island; Westchester.)	
Oak Pt. to Bronx R	00, 40
College Pt., N. Y.	01, 119, 1305
Bowery B., N. Y.	02, 579, 964, 966
Berrien Isld., N. Y., and N. Brother Isld.	03, 640, 888, 891, 895
Lawrence Pt., and between E. 13th and E. 18th Streets	04, 709, 1096, 1098, 1101, 1105
Bowery B.	05, 718, 1006 06, 796
E. 26th and 29th Streets	07, 814
W. Shore, between 61st and 68th Streets, near mouth of Bronx R. and foot of Grand Street	10, 1017, 1018
Pot Cove, near Astoria, N. Y.	12, 1293
About Great and Little Mill Rocks, Hell Gate, passage, abrogated	12, 1293
East R., N. Y., at Randalls Isld., Wards Isld., and Sunken Meadow, modification	10, 1018 11, 1077
East R., Wis. (see Green Bay)	06, 797
East Twin R., Wis.	07, 815
Ecorse, Mich., at and near	96, 23, 2900, 2901, 2904
Edenton, N. C.	07, 815
Edenton B., N. C.	07, 815
Edgemoor, Del. (see Delaware R.)	03, 640, 981
Edmunds, Wash.	93, 462, 3472
Eighteenmile Cr. (See Olcott H.)	
Eighteenth Street, New York, N. Y.	03, 640, 895
Elizabeth, Pa. (See Monongahela R.)	03, 640, 1698 07, 815
Elizabeth City, N. C.	02, 579, 1127
Elizabeth Pt. (See New York.)	
Elizabeth R., Va.	00, 40, 1791 03, 640, 1089
Elizabeth R., Va., modification of lines on right bank between Sewell Pt. and Tanners Pt., near Norfolk (see Norfolk)	11, 1076
Elizabeth (S. Branch), opposite Norfolk Navy Yard, and Tanners Creek, Va., modification (see Southern Branch)	11, 1077
Elizabethport, N. J.	05, 718, 1056, 1059
Ellis Creek, Cal. (see San Francisco B.)	06, 797
Ellis Isld., New York H. (q. v.), N. Y.	96, 23, 874 97, 23, 1075
Ellis Isld., N. Y.	02, 579, 988 05, 718, 1025
Erie Basin, Buffalo, N. Y. (see Buffalo)	01, 119, 3349
Erie H., Pa.	97, 24, 3265
Eureka, Cal. (see Humboldt Bay)	06, 797 10, 1017
Everett H., Wash. (See Snohomish)	94, 424, 2627 11, 1077

Place.	Reports of Chief of Engineers.
Fairhaven H., Mass.	03, 640, 820
Fairport H., Ohio	95, 21, 472, 3130
Fall River H., Mass.	00, 40, 1311
Fernandina H., Fla.	90, 334, 1545
Fields Landing, Cal.	10, 1017
Fifty-fourth Street, New York, N. Y.	04, 709, 1098
Fifty-ninth Street, New York, N. Y.	89, 368 04, 709, 1101
First Street, San Francisco, Cal.	10, 1018
Firth-Sterling Steel Co., D. C.	11, 1077
Fivemile R. H., Conn.	92, 398, 730
Flavel. (See Youngs Bay.)	
Flushing R., Long Isld., N. Y. (see New York)	11, 1077
Fore R., Portland, Me.	01, 118, 1027
Ft. Hamilton. (See New York.)	
Fort Howard, Wis.	95, 21, 472, 2687
Fort Lee, N. J., to Guttenberg	03, 640, 905
Fort Norfolk. (See Norfolk.)	
Fort Pulaski, Savannah, Ga.:	
Savannah R. in vicinity of quarantine station	93, 462, 1610
Fort San Jacinto. (See Galveston.)	
Fox R., Wis. (see Oshkosh.)	03, 640, 1883, 1884
Oshkosh, Wis.	06, 797
City of Green Bay	07, 815 10, 1018
Fox R., at Oshkosh, Wis., extension and reestab.	12, 1293
Galveston B., Texas City, Tex.	04, 709, 2026
Galveston H., Tex.	96, 23, 1560 98, 34, 1571
Fort San Jacinto	00, 40, 2475
Georgetown H., S. C.	07, 815
Givans Cr. (See E. Chester.)	
Glen Osborne, Pa. (see Ohio R.)	09, 910
Gowanus B., N. Y. (see New York.)	02, 579, 983
Grand Rapids, Mich.	05, 718, 2215
Grand R., Mich.	05, 718, 2215
Grand Street, New York, N. Y.	10, 1018
Grassy Pt., Minn. (see St. Louis Bay)	95, 21, 472, 2588
Gravesend B., N. Y. (see New York)	04, 709, 1110 07, 814 12, 1293
Grays H., Wash., at Hoquiam	95, 21, 473, 3547
Greatmill. (See New York.)	
Green B., Wis. (see Fox R.)	03, 640, 1884
East R.	06, 797 10, 1018
Green B. H., Wis.	95, 21, 472, 2687
Greenport H., N. Y.	94, 422, 716 05, 718, 1003
Greenville, N. J.	00, 40, 1475
Greenwich H., Conn.	96, 23, 815
Grosse Isle, Detroit R., Mich.	96, 23, 2909
Grossepoint, Mich.:	
Lake St. Clair	95, 21, 472, 3069
Guttenberg, N. J. (see Ft. Lee; Howards Bay; New York)	01, 118, 1273 03, 640, 905
Hackensack R., N. J.	08, 865
From Little Ferry to Hackensack	10, 1018
Hackensack, N. J.	10, 1018
Hague, The, Va. (see Norfolk H.)	04, 709, 1470
Hampton (Jones and Herbert) Creek, Va.	07, 815
Hampton Roads, Va. (see James R.; Jones Cr.)	06, 797
Hancock. (See Houghton.)	
Hanging Rock, Ohio	04, 709, 2487
Hannibal, Mo. (see Mississippi R.)	05, 718, 1657
Harlem R. (see Spuyten Duyvil; New York)	94, 422, 786
Harriet Isld., Minn.	06, 797

Place.	Reports of Chief of Engineers.
Harrison, N. J. (see Passaic R.)	07, 815
Hastings upon Hudson, N. Y. (see Hudson R.)	07, 815
Hawaii	11, 1077
Hazelwood, Pa	03, 640, 1702
Hell Gate, passage, East R., N. Y., about Great and Little Mill Rocks, pierhead and bulkhead lines abrogated. (see East R.)	12, 1293
Herbert Creek, Va	07, 815
Hillsboro B., Fla	08, 865 12, 1293
Hillsboro R., Fla. (see Tampa, Fla.)	01, 119, 1763 07, 815
Hilo H., Hawaii	11, 1077
Hogans Creek, Fla. (see St. Johns)	07, 815
Homestead Br., Pa. (see Monongahela R.)	02, 579, 1912
Honolulu, Hawaiian Islds	99, 39, 3769 00, 40, 5095
Honolulu B., Hawaii	10, 1018
Hoquiam, Wash. (see Grays H.)	93, 462, 3472
Hoquiam R	95, 21, 473, 3547
Hospital Creek, Fla. (see St. Augustine H.)	06, 797
Houghton and Hancock, Mich	92, 303, 2165 99, 39, 2723
Howards B., Minn. and Wis. (see Duluth)	11, 1076
Hudson R., N. Y. (see New York H.; Yonkers):	
Guttenberg, N. J., Troy, N. Y., Pleasant Valley Landing to Bloomers, N. J	01, 118, 1268, 1270
New Baltimore, Troy	02, 579, 961, 962
Albany, N. Y	03, 640, 901, 905
Yonkers	04, 709, 1108
Hastings upon Hudson, N. Y., w. side near Van Wies Pt., below Albany; at Starbuck and Big Stony Isld., Troy	07, 814, 815
Between Adams Street and Burden Iron Works, Troy, N. Y	09, 910
Humboldt B., Cal	91, 427, 3138
Bucksport to Eureka, Cal	06, 797
Fields Landing, Eureka, Cal	10, 1017
Humphreys Creek, Md. (see Sparrows Pt.)	10, 1018
Hunts Pt., N. Y. (see New York)	10, 1018
Illinois R. and Peoria Lake, Peoria, Ill	07, 815
Ilwaco, Wash	93, 462, 3472
Irondale, Wash. (see Irondale)	11, 1077
Ironton, Minn	95, 21, 472, 2588
Jacksonville, Fla. (see St. Johns R.)	03, 640, 1187 04, 709, 1757 07, 815
Jamaica B., N. Y. (see Sheepshead B.)	06, 796 11, 1077
James R., Va. (see Richmond):	
Hampton Roads, Newport News, Va	00, 40, 1761 06, 797
Jamestown, R. I.:	
Conanicut Isld. (Narragansett B.)	99, 39, 1146
Jeffries Pt. (see Boston H.), Mass., modification	11, 1076
Jersey Flats, w. side of Upper B., New York H., extending from mouth of Hudson R. at Jersey City to Constable Pt., Bergen Neck, N. J. (see New York)	91, 425, 965 00, 40, 1475
Jones Creek, Va	07, 815
Jones Creek, near Hampton, Va., extension	12, 1293
Kahului H., Isld of Maui, Hawaii	09, 911 11, 1076
Kaighn Pt. (See Philadelphia,)	
Kansas City, Kans. (see Missouri R.)	10, 1018
Kansas City, Mo. and Kans	94, 423, 3159 02, 579, S. 213 05, 718, 1708
Kansas R., Kansas City, Kans	10, 1018
Kansas R., Kansas City, Mo. and Kans	05, 718, 1708
Kaw (see Kansas) R., Mo. and Kans.	05, 718, 1708
Kenosha H., Wis	98, 23, 2568 00, 40, 3776 12, 1293
Kewaunee H., Wis	97, 24, 2785
Key West, Fla	06, 797
Kill van Kull, N. Y. (st. monuments). (See New York)	03, 141 04, 129
La Conner, Wash. (see Swinowsish Slough)	93, 462, 3472 09, 911
Lake Superior, Minn	03, 640, 1828
Lake Union, Wash. (see Seattle)	08, 865 10, 1018
Lake Washington. (See Seattle), Wash	10, 1018
Lamberts Pt. (See Norfolk.)	
Laporte, Tex	00, 40, 2476
Lavaca B., Tex	02, 579, 1402
Lawrence Pt., N. Y. (see East R.)	03, 640, 891
League Isld. Navy Yard, Pa. (see Delaware R.)	02, 579, 1041
Lermonds Cove, Me	03, 640, 727
Licking R., Ky., at its mouth	96, 23, 2126
Little Ferry, N. J. (see Hackensack)	10, 1018
Little Mill. (See New York.)	
Lock No. 1, Monongahela R., Pa	07, 815
Lock No. 4, Monongahela R., Pa	07, 815
Long Isld., N. Y	11, 1077
Long Isld. City:	
East R., N. Y	98, 34, 1025
Lorain H., Ohio	11, 1077
Los Angeles H., Cal	11, 1077
Lubec, Me	91, 424, 621 01, 118, 1018
McKeesport, Pa. (see Monongahela)	02, 579, 1912 04, 709, 2551 05, 718, 1865
Manitowoc, Wis	96, 23, 2565 07, 815 09, 911
Manitowoc R., Manitowoc, Wis	07, 815 09, 911
Mare Isld. Strait (see San Francisco; Vallejo), Cal	04, 709, 3430 10, 1018
Marine City, Mich	96, 23, 2747
Marine Park. (See Boston.)	
Marquette, Mich	89, 366, 2027
Martinez. (See San Francisco.)	
Maryland Steel Co., Md	10, 1018
Marysville, Wash	93, 462, 3475
Marshy Pt. (See Raritan Br.)	
Martinez. (See San Francisco.)	
Matagorda B., Tex	05, 718, 1516
Maumee R., Ohio (see Toledo)	03, 640, 2107
Between Oakdale Avenue and Ed. Ford Plate Glass Works	10, 1017
Milford H., Conn	95, 21, 471, 893
Milwaukee, Wis.:	
Milwaukee R	93, 462, 2788
Between Cherry and Walnut Streets	95, 21, 472, 2686
Mingo, Ohio	04, 709, 2482
Minnesota Pt., Minn. and Wis. (see Duluth)	09, 911
Mission Rock, Cal. (see San Francisco)	03, 640, 2202 10, 1018
Mississippi R., Moline, Ill	07, 815
Mississippi R., Iowa	07, 815

Place.	Reports of Chief of Engineers.
Mississippi R., Minn	03, 640, 1513
St. Paul, Minn., Harriet Isld	06, 797
St. Louis, Mo	03, 640, 1455
Mississippi R., Hannibal, Mo	05, 718, 1657
Missouri R., St. Joseph, Mo	04, 709, 2334
Missouri R., Kansas City, Mo. and Kans	02, 579, S. 213 05, 718, 1708
Missouri R., Omaha, Nebr	09, 911
Mobile, Ala	06, 797
Mobile R., Mobile, Ala	06, 797
At Pinto Isld	09, 910
Moline, Ill	07, 815
Monongahela R., Pa. (see Pittsburgh, Locks):	
Homestead Branch to McKeesport	02, 579, 1912 03, 640, 1698, 1702, 1708 04, 709, 2551, 2553 05, 718, 1865, 1869
Pittsburgh H., Locks Nos. 1 and 2	06, 797
Between Lock No. 4 and Brownsville, Pa.; n. side above Lock No. 1; between Elizabeth and Lock No. 4, Pa	07, 815
Brownsville, near Locks Nos. 5 and 6, Rices Landing, Pa	09, 911
Monongahela R., Pa., modification from mouth to above Pittsburgh, Cincinnati, Chicago & St. Louis R. R. br. at Try Street, and modification on left bank, between S. 6th Street and S. 9th Street, and at Dam No. 1, Pittsburgh, Pa	12, 1293
Morse Creek, N. J. (see Arthur Kill)	09, 910
Mount Hope B., Mass	00, 40, 1311
Muscatine, Iowa	07, 815
Muskingum R., above and below L. and D. 10, Zanesville, Ohio	09, 911
Mystic R., Mass. (see Boston)	02, 579, 887
Napa R., Napa, Cal	94, 424, 2522
Natrona, Pa. (see Allegheny R.)	11, 1076
Navesink. (See New York.)	
Neuse R., N. C	00, 40, 1837
New Astoria, Oreg	96, 23, 3320
Newark B., N. J	01, 118, 1276
Staten Isld	04, 709, 1177 05, 718, 1056
New Baltimore, N. Y. (see Howards Bay; Troy)	02, 579, 962
New Bedford H., Mass	03, 640, 820
Newbern, N. C. (see Trent R.)	03, 640, 1114 11, 1077
Newbern H., N. C	00, 40, 1837
New Brunswick. (See New York.)	
New Castle, Del	91, 425, 1225
New Haven H., Conn	95, 21, 471, 882 00, 40, 1366
New Jersey, Staten Isld. Chan	01, 118, 1279
New London H., Conn. (see Shaws Cove)	99, 39, 1189 00, 40, 1363 08, 864
Newport H., R. I	02, 579, 912
Newport News, Va. (see James R.)	06, 797
Newtown Creek (see New York H.), Brooklyn, N. Y	03, 640, 898
Newtown Creek, Borough of Queens and Borough of Brooklyn, N. Y., modification	11, 1077
Newtown Creek, at Metropolitan Avenue, Borough of Queens, N. Y	12, 1293
New Whatcom, Cal. (see Squalicum Creek)	10, 1017
New York B., N. Y., Red Hook, Staten Isld., St. George Ferry	07, 814
New York H., N. Y. (see Arthur Kill; Atlantic Basin; Battery; Bowery; Bronx: Brooklyn; 18th Street; Ellis Isld.; 54th Street; 59th Street; Grand Street; Kill Van Kull; Newtown Creek; 61st Street; 64th Street; 66th Street; 13th Street; 32d Street; 37th Street; 29th Street; 26th Street; 23d Street; Staten Isld.):	
East R	97, 23, 1061
Between Bungay and Cabot Streets, Oak Pt	99, 39, 1255 00, 40, 1455, 1457
West side of Rikers Isld	99, 39, 1254
Between E. 23d and E. 24th Streets	99, 39, 1258
Harlem R	94, 422, 786
At its entrance into East R	96, 23, 870
Hudson R	97, 23, 1067, 1070
New York H. and adjacent waters (see Brooklyn; Ellis Isld.; Harlem R.; Long Isld. City; Raritan Br.; Rikers Isld.; Spuyten Duyvil Creek):	89, 368, 807 00, 40, 1455, 1457 97 723, 1070
Kill van Kull and Shooters Isld	90, 332, 786
E. shore of East R., N. Y., from foot of Broadway, Brooklyn, to Ravenswood, L. I	90, 332, 791
Shore of New Jersey from Communipaw, Jersey City, to Constable Pt., Bergen Neck	90, 332, 794
S. and w. shores of Staten Isld. from Fort Wadsworth to Elizabeth Pt., N. J., and w. bank of Arthur Kill from Perth Amboy to Elizabeth Pt., N. J	90, 332, 796
E. shore of East R., N. Y., Buttermilk Chan., and both shores of Gowanus B. from Lawrence Pt. to Fort Hamilton	90, 333, 810
W. bank of Hudson R. along Jersey City front from Weehawken Cove to Communipaw Ferry	90, 333, 816
E., n., and w. shores of Newark B., N. J	90, 333, 818
W. bank of North R. from Weehawken Cove to Guttenberg, N. J.; e. bank of North R. from W. 80th Street to the Battery, New York City; the Battery; and n. and w. shores of East R. from the Battery to E. 81st Street, New York City	90, 333, 820
Raritan B. and R., N. J.; n. shore from Perth Amboy to Crab Isld., and s. shore from Crab Isld. around South Amboy to Cheesequakes Creek	90, 333, 826
Ellis Isld., N. J	90, 333, 829
Pierhead line for w. half of s. shore of Staten Isld. from Sequines Pt. to Wards Pt	90, 333, 831
Modification of pierhead line on e. shore of East R. from 1st Street, Brooklyn, to br. across Bushwick Creek at Kent Avenue	90, 333, 833
E. side of Manhattan Isld. from E. 81st Street n. to 3d Avenue br. w. side of Manhattan Isld. from W. 81st Street n. to Spuyten Duyvil Creek; w.	

Place.	Reports of Chief of Engineers.
New York H., etc.—Continued.	
bank of North R. from Guttenberg, N. J., n. to Bloomer, N. J.; Spuyten Duyvil Creek through the Harlem R. to 3d Avenue Br.; n. shore of Bronx Kills from 3d Avenue Br. e. to Bungay Street (Port Morris); and Blackwell, Ward, Randall, and Sunken Meadow Islds	91, 424, 958
Raritan R. from Crab Isld. to head of navigation at New Brunswick, N. J	91, 424, 960
Newtown Creek, N. Y., between terminals at Whale Creek and Dutch Kills estab. by Sec. of War, Feb. 8, 1890, and Metropolitan Avenue (the present head of navigation of the creek)	91, 424, 961
East R., N. Y., along the n. shore from Port Morris e. to Throg Neck, including entrance to Bronx R. and Westchester Creek; along the s. shore from Lawrence Pt. e. to Willetts Pt., including Bowery and Flushing B., and around North Brother, South Brother, Berrien, and Rikers Islds	91, 425, 963
Modification of p. and bulkhead line on the n. shore of Staten Isld., between John Street and Houseman Avenue, produced	91, 425, 973
Great Mill and Little Mill Rocks, East R	92, 398, 849
E. shore of Gravesend B. from Fort Hamilton to Coney Isld	92, 398, 850
S. shore of Raritan and Sandy Hook Bs. from Chesapeake Creek to the highway br. across Shrewsbury R. at Navesink Highlands	92, 398, 851
Modification of H. lines in Jersey flats, in front of Bayonne, N. J., to permit solid filling and constr. by R. G. Packard outside the estab. H. lines	92, 398, 854
Modification of H. lines estab. Jan. 9, 1891 (91, 963), on the n. shore of East R., between Oak Pt. and Hunts Pt	92, 398, 859
Modification of pierhead line estab. Mar. 4, 1890 (90, 1892), on the Arthur Kill, in front of Perth Amboy, N. J	92, 398, 862
Modification of H. lines around Rikers Isld., East R., N. Y	93, 461, 1085
Modification of H. lines on e. shore of East R. at Ravenswood, Long Isld., N. Y	93, 461, 1090
Harlem R	96, 23, 870
Ellis Isld. (q. v.)	96, 23, 874
Near foot E. 89th Street	97, 23, 1081
W. 23d Street to W. 81st Street	97, 23, 1067
Modification on Harlem R. and Spuyten Duyvil Creek	97, 23, 1077
Modification on Ellis Isld	97, 23, 1075
Arthur Kill, Bronx R.; College Pt.; Guttenberg, N. J	01, 118, 119, 1027, 1266, 1279, 1305 02, 579, 964, 966, 983, 986, 988
Shooters Isld.; Ellis Isld.; Gowanus B.; Buttermilk Chan	03, 640, 888, 891, 895, 965
New York H., etc.—Continued.	
Battery; Newark B., along Staten Isld. shore; Gravesend B., at Coney Isld	04, 129, 709, 1096, 1098, 1101, 1105, 1110, 1127, 1175, 1177
Arthur Kill, East R.; Elizabethport, N. J.; Ellis Isld.; Newark B.; Rossville; Smoking Pt.; Staten Isld. Sound	05, 718, 1006, 1025, 1056, 1059, 1062
St. Georges, Staten Isld	04, 709, 1175 06, 796 07, 814
Gravesend B	07, 814
Niagara R., N. Y., at Tonawanda	08, 865 12, 1293
Niagara R., N. Y. (see Black Rock, Squaw Island):	
Erie Basin and Black Rock H	00, 40, 4156, 4159 01, 119, 3349 08, 865
Norfolk, Va., Paradise Creek	07, 815
Norfolk (near), Va	11, 1076
Norfolk H., Va.:	
Smith Creek, Atlantic City br	03, 640, 1089
Smith Creek, The Hague	04, 709, 1470
Tanners Creek, Va	06, 797 11, 1077
Norfolk and Portsmouth Hs. (see Elizabeth R.)	89, 366, 977
Norfolk and Portsmouth Hs., Va., and adjacent waters:	
E., s., and w. branches of Elizabeth R.; Elizabeth R. below w. branch, and bulkhead lines in Norfolk H. from Norfolk & Western R. R. br. and U. S. navy yard to Lamberts Pt	90, 334, 1082
S. branch of Elizabeth R. and Elizabeth R. below Fort Norfolk	90, 333, 1080
Norfolk Navy Yard, Va	92, 399, 1097 11, 1077
Normandie, N. J. (see Shrewsbury)	10, 1018
North Brother Isld., N. Y. (see New York)	03, 640, 888
North R. (See New York H.)	
North Tonawanda, N. Y	00, 40, 4159
Norwalk H., Conn	99, 39, 1202
Oakdale H., Ohio	10, 1017
Oakland H., Cal. (see San Francisco)	94, 424, 2505, 2506
Oak Pt. (See New York.)	
Oconto H., Wis	93, 462, 2784 94, 424, 2124
Ocosta, Wash	93, 462, 3472
Ohio R., Ky. and Ohio	04, 709, 2487
Ohio R., Ohio	94, 423, 1894 04, 709, 2482
Ohio R., at East Liverpool, Ohio	11, 1077
Allegheny City, Pa	01, 119, 2709
Ohio R., Pa. (see Pittsburgh)	04, 709, 2554
Brunot Isld., just below Pittsburgh; right bank, just below mouth of Allegheny R., Pittsburgh H., Pa	07, 815
Dam 3, Glen Osborne, Pa., to Dam 5, near Rochester, Pa	09, 911
Olcott H., Eighteenmile Creek, N. Y	04, 709, 3378
Olympia, Wash	92, 399, 2794 96, 23, 3391 97, 24, 3484

Place.	Reports of Chief of Engineers.
Omaha, Nebr. (see Missouri R.)	09, 911
Oshkosh:	
Fox R., Wis	99, 39, 2819
Oshkosh, Wis. (see Fox R.)	03, 640, 1883 06, 797
Oswego, N. Y	93, 462, 3178
Pamlico R., N. C	01, 119, 1570
Paradise Creek, Va. (see Norfolk)	07, 815
Pasquotank R., N. C	02, 579, 1127
Passaic R., N. J.:	
W. bank, near Harrison, N. J	07, 814, 815 08, 865
Patapsco R., Md. (see Baltimore)	03, 640, 1033 11, 1076
Patchogue R	94, 422, 719
Pawtucket (Seekonk) R., R. I	03, 640, 825
Pearl H., Hawaii	12, 1293
Penobscot R., Me	01, 118, 1022
Pensacola H., Fla	01, 119, 1806
Peoria, Ill	07, 815
Peoria Lake, Ill. (see Illinois R.)	07, 815
Perth Amboy. (See New York.)	
Philadelphia, Pa. (see Camden; Delaware R.; League Island)	09, 910 10, 1018 11, 1077
E. shore of Delaware R., from Kaighn Pt. to Cooper Pt., along the water front of Camden, N. J	91, 425, 1121
W. shore of Delaware R., from Moore to Otis Streets, along the water front of Philadelphia, Pa	91, 425, 1125
Delaware R	73, 887 74, ii, 145, 146 77, 270 78, 431, 443 79, 462 94, 423, 864
Pinto Isld., Ala	09, 910
Pittsburgh and Davis Isld. Dam, Pa.:	
Ohio R	95, 21, 471, 2420
Pittsburgh, Pa. (see Monongahela; Ohio; Smithfield; Tenth st.)	03, 640, 1702, 1706, 1709
Allegheny City	95, 21, 471, 2420 01, 119, 2709 02, 579, 1912 05, 718, 1865, 1869 07, 815
Allegheny R	96, 23, 2219
Monongahela R	95, 21, 471, 2420 96, 23, 2215
Pittsburgh H., Lock No. 1, Pa	06, 797
Pittsburgh, Pa., Lock No. 2	05, 718, 1869
Pittsburgh H., Lock No. 2, Pa	06, 797
Pleasant Valley Landing. (See Howards Bay.)	
Pocomoke R. (See Snow Hill.)	
Pt. San Pablo. (See San Francisco.)	
Portage Lake, Mich	89, 274, 2027 90, 246, 2323 91, 316, 317, 426, 2519
Port Angeles, Wash	93, 462, 2472
Port Costa. (See San Francisco.)	
Port Chester H., N. Y	01, 118, 1261
Port Haddock, Wash. (see Port Townsend)	11, 1077
Port Huron, Mich. (see St. Clair):	
Black R	93, 462, 2958
Portland H., Me. (see Back Cove; Fore R.)	01, 118, 1027
Portland, Oreg. (see Willamette R.)	92, 399, 2869 00, 40, 4456
Portland H., Oreg	06, 797
Port Lavaca, Tex	02, 579, 1402 05, 718, 1516
Port Morris, N. Y. (see New York.)	04, 709, 1106
Port Orchard H., Wash. (Sinclair Inlet), Bremerton and Charleston	10, 1017
Port Perry, Pa	04, 709, 2553 05, 718, 1869
Port Townsend, Wash	93, 462, 3472
Port Townsend, Wash., Irondale to Port Haddock	11, 1077
Port Townsend B., in front of Irondale, Wash	11, 1077
Portsmouth. (See Norfolk.)	
Pot Cove, left bank East R., near Astoria, N. Y., modification of pierhead and bulkhead lines (see East R.)	12, 1293
Potomac R., Washington, D. C. (see Anacostia R.; Washington)	04, 709, 1351
Potomac R., Va., at Alexandria	09, 910
Potomac R., Aqueduct Br. to foot of 26th Street, D. C	11, 1077
Potomac R., D. C., from mouth of Anacostia R. downstream in front of Firth-Sterling Steel Co., extension	11, 1077
Providence H. and R., R. I	03, 640, 825
Puget Sound, Wash., around Duwamish Head and Alki Pt	95, 21, 473, 3543 10, 1018
Queens. (See Borough of; Newtown Cr.; New York.)	
Quincy B., Ill	90, 334, 2010
Rahway R., N. J	01, 118, 1279
Randalls Isld. (Sunken Meadow) (see East R.), New York, N. Y	10, 1018
Randalls Isld., East R., N. Y	11, 1077
Raritan Bay. (See New York.)	
Raritan Br. and Marshy Pt.:	
Raritan R., N. J	96, 23, 819
Ravenswood. (See New York.)	
Raymond, Wash	10, 1017
Red Hook, N. Y. (see New York.)	07, 814
Red Hook Pt., N. Y. (see Brooklyn)	09, 910
Rices Landing, Pa. (see Monongahela R.)	09, 911
Richmond to City Pt., Va.:	
James R	90, 333, 1012 00, 40, 1761
Rikers Isld., N. Y. (see New York City, etc.):	
East R	95, 21, 471, 1017
Rochester, Pa. (see Ohio R.)	09, 911
Rockaway Inlet (see Sheepshead B.), N. Y	11, 1077
Rockland H., Me	95, 21, 471, 595 00, 40, 1138 03, 640, 727
Rossville, Staten Isld., N. Y. (see New York)	05, 718, 1062
Rouge R., Mich	05, 718, 2296
Rude Waterway, Alaska	11, 1076
Sabine Pass, Tex.:	
H	96, 23, 1521
Sabine Pass, Tex	04, 709, 1968
Saginaw, Mich	05, 718, 2235
Saginaw R., Mich	05, 718, 2235
Sailors Encampment Isld., Mich.:	
St. Marys R	96, 23, 2897
St. Augustine H., Fla	91, 425, 1685
Hospital Creek	06, 797
St. Clair Lake, Mich	95, 21, 472, 3069
Port Huron	98, 34, 2607
St. George Ferry Terminal, N. Y. (see New York)	07, 814
St. George, Staten Isld., N. Y	04, 709, 1175 06, 796
St. Georges Sound, Fla	00, 40, 2158
St. Johns R., Fla	03, 640, 1187
Near Jacksonville	04, 709, 1757
Hogan Creek, Jacksonville	07, 815
St. Joseph, Mo. (see Missouri R.)	04, 709, 2334

Place.	Reports of Chief of Engineers.
St. Joseph H., Mich	94, 424, 2258 98, 34
St. Lawrence R., N. Y.:	
Alexandria B	02, 579, 2338
St. Louis, Mo. (see Mississippi R.)	03, 640, 1455
St. Louis B. and around Grassy Pt., Minn. and Wis. (see Duluth)	95, 21, 472, 2588
St. Marys R. (See Sailors Encampment; Sault Ste. Marie.)	
St. Paul, Minn. (see Mississippi R.)	03, 640, 1513 06, 797
San Bruno Canal, Cal	10, 1018
San Diego, Cal	12, 1298
San Diego H. and adjacent waters, Cal	90, 334, 2904 92, 399, 2640
Sandusky H., Ohio	98, 34, 2733
Sandy Hook B., N. J., opposite mouth of Compton Creek (see New York)	10, 1018
San Francisco, Cal. (see Alameda; First Street; Stuart Street)	10, 1018
Mouth of Ellis Creek	06, 797
San Francisco B., Cal.:	
Between Pt. San Pablo and Castro Rocks	09, 911
Between 1st and Stuart Streets	10, 1018
E. shore of San Francisco B., from Pt. San Pablo s. in front of Oakland and Alameda	94, 424, 2505, 2506
Between San Pablo and Oakland	99, 39, 3194
San Francisco H., Cal	01, 119, 3460
Mission Rock, n. of; n. of China Basin	03, 640, 2202 10, 1018
To Bruno Canal	10, 1018
San Francisco H. and adjacent waters	91, 426, 2948
Water front of the city of San Francisco and at Mission Rock, bay of San Francisco	90, 334, 2890
Port Costa and Martinez on the s. shore of Carquinez Strait, and Benecia on the n. shore and e. shore of Mare Isld. Strait	90, 334, 2893
San Jacinto B., Tex	00, 40, 2476
San Pablo, Cal. (see San Francisco)	09, 911
San Pedro, Cal	06, 797
San Pedro, Wilmington H. (q. v.), Cal	91, 426, 2976 92, 399, 2638
San Pedro (inner) H., Cal	09, 911
Sault Ste. Marie, Mich.:	
St. Marys R	93, 462, 3037
Savannah, Ga. (see Fort Pulaski)	98, 34 89, 367, 1285
Savannah H. and R., Ga	01, 119, 1730
Schuylkill R. (see Delaware R.), Pa	09, 910
Seabright, N. J.: (See Shrewsbury R.)	
Shrewsbury R	94, 423, 823
Seabright, N. J	01, 118, 1282 10, 1018
Seattle, Wash. (see Puget Sound; Lake Washington)	93, 462, 3472 95, 21, 473, 3543 99, 39 07, 815
Lake Union	08, 865
Canal waterway	10, 1018
Seekonk (Pawtucket, q. v.) R., R. I	03, 640, 825
Sequines Pt. (See New York.)	
Severn R., Md	01, 119, 1396
Sewell Pt., Va. (see Elizabeth R.)	11,. 1076
Shaws Cove, New London H. (q. v.), Conn	93, 461, 997
Shaws Cove, Conn	08, 864
Sheepshead B. and Atlantic Ocean at e. end of Coney Isld., N. Y., and Jamaica B., and through Rockaway Inlet, N. Y	11, 1077

Place.	Reports of Chief of Engineers.
Shelton, Wash	93, 462, 3475
Shooters Isld., N. Y. (see New York)	02, 579, 986
Shrewsbury R., N. J. (see New York; Seabright)	01, 118, 1282 08, 865
Between Seabright and Normandie, N. J	10, 1018
Sidney, Wash	93, 462, 3472
Sinclair Inlet, Wash. (see Port Orchard)	10, 1017
Sixty-first Street, New York, N. Y.	10, 1017
Sixty-fourth Street, New York, N. Y	10, 1017 89, 368
Sixty-sixth Street, New York,, N. Y	04, 709, 1101
Smith Creek, Va. (see Norfolk)	03, 640, 1089
Smithfield Street, Pittsburgh, Pa	03, 640, 1706
Smoking Pt., Staten Isld., N. Y. (see Arthur Kill, New York)	05, 718, 1062
Snohomish, Wash	93, 462, 3475
Snohomish R., near Everett H., Wash	11, 1077
Snow Hill, Md.:	
Pocomoke R	96, 23, 994
Somerville, Mass	02, 579, 887
South Amboy. (See New York.)	
South Bend, Wash	93, 462, 3472 08, 865
South Brother Island. (See New York.)	
South Haven H., Mich	10, 1018
Southern Branch, Va.:	
Elizabeth R	96, 23, 1094
Southport, N. C	01, 119, 1572
Sparrows Pt. (see Baltimore H.), Md	03, 640, 1033
Or Humphreys Creek, n. side of Maryland Steel Co.'s property	10, 1018
Spuyten Duyvil Creek (see Harlem R.; New York), N. Y	97, 23, 1077
Squalicum Creek waterway, Wash.	10, 1017
Squaw Isld., N. Y.:	
Niagara R	94, 424, 2452
Stamford H., Conn	90, 332, 682 00, 40, 1368 06, 796
Starbuck, N. Y. (see Hudson R.)	07, 815
Staten Isld. (see New York H.), N. Y	89, 368 03, 141 04, 129, 709, 1175, 1177 06, 796 07, 814
Staten Isld. Sound (see Arthur Kill; Newark Bay; New Jersey; New York; Smoking Pt.), N. Y. and N. J	05, 718, 1056, 1059, 1062
Steilacoom, Wash	93, 462, 3472
Steinway, N. Y	02, 579, 964
Steubenville, Ohio	04, 709, 2482
Stony Pt., N. Y. (see Buffalo)	04, 709, 3316
Stuart Street, San Francisco, Cal	10, 1018
Sunken Meadow, East R., N. Y. (see Randalls Island; East R.)	11, 1077
Superior B., Minn. and Wis. (see Duluth)	94, 423, 2039 97, 23, 2647
Superior, Wis.:	
Allouez B	93, 462, 2695
Superior H., Wis	00, 40, 3642
Swinomish Slough, Wash., at La Conner	09, 911
Tacoma, Wash	93, 462, 3472 99, 39
Tacoma H., Wash	02, 579, 2432
Tampa, Fla	01, 119, 1763
Hillsboro R	99, 39, 1643 00, 40, 2084
Tanners Creek, Va. (see Norfolk)	06, 797 08, 865 11, 1077
Tanners Pt., Va. (see Elizabeth)	11, 1076
Tenth Street, Pittsburgh, Pa	03, 640, 1706

Place.	Reports of Chief of Engineers.
Texas City, Tex. (see Galveston Bay)	04, 709, 2026
Thames R., Conn	00, 40, 1363
Thirteenth Street, New York, N. Y.	03, 640, 895
Thirty-second Street, New York, N. Y	04, 709, 1098 05, 718, 1006
Thirty-seventh Street, New York N. Y	05, 718, 1006
Throg Neck. (See New York.)	
Toledo, Ohio:	
Maumee R	96, 23, 3091 99, 39, 3078
Toledo H., Ohio	03, 640, 2107 10, 1017, 1018
Tonawanda, N. Y. (see New York)	08, 865
Tottenville, N. Y	06, 797
Trent R., at Newbern, N. C	11, 1077
Trent R., N. C	00, 40, 1837 03, 640, 1114
Trenton, N. J. (see Delaware R.)	11, 1077
Troy, N. Y. (see Adams St.; Burden Iron Works; Hudson R.)	01, 118, 1268 02, 579, 961 07, 815
Troyto New Baltimore:	
Hudson R	90, 332, 770
Tufts Pt., N. J. (see Arthur Kill	10, 1018
Twenty-ninth Street, New York, N. Y	04, 709, 1096 07, 814
Twenty-sixth Street, New York, N. Y	04, 709, 1096 07, 814
Twenty-third Street, New York, N. Y	07, 814
Twin Rs. (see Two Rivers H.), Wis	06, 797
Two Rivers H., Wis	06, 797 07, 815
Urbana Creek, Va	04, 709, 1359
Vallejo, Cal	04, 709, 3430 10, 1018
Vancouver, Wash	92, 399, 2794
Van Wies Pt., N. Y. (see Hudson R.)	07, 814
Wands Pt., Oreg	06797,
Wards Isld. (see East R.), N. Y	11, 1077
Wards Pt. (See New York.)	
Washington, D. C. (see Potomac R.)	04, 709, 1351
Anacostia R	92, 398, 1079
Potomac R	99, 39, 1463
Washington, N. C	01, 119, 1570
Waterway (canal), Wash	10, 1018
Waukegan H., Ill	97, 24, 2786
Weehawken Cove. (See New York.)	
Weems, Va	05, 718, 1182
Westchester, N. Y. (see New York.):	
From estuary at East R	94, 423, 790
West Seneca. (See Buffalo.)	
Whale Cr. (See New York.)	
Willamette R., Oreg	00, 40, 4456 06, 797
Willets Pt. (See New York.)	
Willapa R., Wash	08, 865 10, 1017
Wilmington, N. C. (see Cape Fear)	96, 23, 1147 06, 797
Wilmington H., Cal. (see San Pedro)	95, 21, 473, 3287 06, 797
Wilmington H., Del. (see Christiana)	11, 1076
Wilson, Pa	03, 640, 1699 05, 718, 1865
Wishkah R. (see Chehalis), Wash	06, 797
Yellow Mill Chan. (see Hudson R.), Conn	07, 814
Yonkers, N. Y. (see Hudson R.)	04, 709, 1108
Hudson R	98, 34, 1072
Youngs B., Oreg., near Astoria	96, 23, 3322
Youngs B., Flavel, Oreg.:	
Columbia R	93, 463, 3537
Zanesville, Ohio (see Muskingum R.)	09, 911

SPECIAL SUBJECTS.

REPORTS, CHIEF OF ENGINEERS, U. S. ARMY, 1866-1912.

SECTION 4.—WRECK REMOVALS FROM NAVIGABLE WATERS.

NOTE.—The following table consists of the names of navigable waterways, the names arranged alphabetically, from which wrecks have been removed from time to time under the direction of the Chief of Engineers, U. S. Army. (See also p. 2116 of this Index.)

ABBREVIATIONS: Brg.—barge, Bk.—bark, Br.—brig, C. b.—canal boat, F. b.—ferryboat, L.—lighter, P. b.—pilot boat, P.—pungy, Sch.—schooner, Sc.—scow, Sh.—ship, Sl.—sloop, Str.—steamer, T.—tug.

Locality and vessel.	Reports of Chief of Engineers.
Absecon Inlet, N. J.:	
Sh. Geestemunde	93, 128, 1182
Sch. A. T. Coleman (parts of)	01, 262, 1351, 1352
Sch. Rival[1]	05, 186, 1123
Sch. A. L. Lee	
Str. (yacht) Viva	09, 224, 1184
Str. Brazoria	11, 278, 1401
Albemarle Sound, N. C.:	
Str. I. D. Coleman	93, 183, 1449
Sch. Marion A. Greene[2]	03, 228, 1088
Str. Tourist	08, 280, 1275
Alexandria H., Va.:	
Brg. ——	09, 272, 1249
Algiers, La.:	
Sh. Ile Marthe	89, 201, 1560
Alpena H., Mich.:	
Str. Shamrock	06, 663
Sch. Harvey Bissell	09, 780, 2119 10, 859, 2280
Ambrose Chan. (8 m. e. of), N. Y.:	
Sch. Garfield White	12, 253, 1298
Anacostia R., D. C.:	
7 coal barges, canal boats, etc.	08, 263, 1253 09, 272, 1249
Anclote Anchorage, Fla.:	
Sch. Addie F. Cole	09, 384
Apalachicola B., Fla.:	
Str. C. Emlin[3]	03, 306, 1236 04, 321, 1792
Apalachicola R., Fla.:	
L. ——	07, 369
L. Georgia	08, 392, 1420
Appomattox R., Va.:	
Sch. J. B. Taylor	05, 235, 1200 06, 250, 1140
Appoquinimink R., Del.:	
Sch. Samuel Applegate	01, 263, 1352
Arkansas R.:	
Str. John Matthews	93, 279, 2121
Str. Eli	95, 286, 2037 96, 248, 1696
Arthur Kill, N. Y. and N. J.:	
C. b. ——	98, 144, 1072
C. b. John Hebron	02, 177, 1038
Brg. Will Sherman	03, 158, 955
C. b. ——	03, 159, 956
Sch. Hattie E. King	12, 278, 1558
Arthur Kill, N. J.:	
C. b. C. C. Morton	04, 148, 1157
C. b. ——	04, 148, 1158
Ashepoo R., S. C.:	
3 lighters	99, 255, 1550
Ashley R., S. C.:	
Sl. Ella[4]	93, 189, 1531
Sl. ——	94, 174, 1128
Wreckage	95, 198, 1447
T. Douglass	99, 254, 1550
Brg. Phosphate (Agostine C.[5])	03, 257, 1140 04, 261, 1565 05, 270, 1258
Ashtabula H., Ohio:	
Sch. Joy	89, 328, 2334 90, 296, 2787
Sch. Pelican	94, 378, 2426
Wreck reported[1]	02, 506, 2293
Brg. Yukon	06, 693 07, 716, 2096
T. Knapp	11, 933, 2508
Assateague Entrance, Va.:	
Sch. Rose	12, 328, 1620
Atlantic City, N. J., near:	
Str. Florida	93, 128, 1182
Str. Ranald[6]	01, 263, 1353 02, 190, 1062 05, 186, 1123 07, 207, 1134, 1135
Brg. Baker	07, 207, 1136
Atlantic Ocean:	
Sch. ——[7]	95, 1356
Sch. Marion F. Sprague[6]	95, 1079
Atlantic Ocean, off Corsons Inlet, N. J.:	
Brg. Maryland	12, 328, 1620
Atlantic Ocean, off Atlantic City, N. J.:	
Str. Ranald	12, 328, 1620
Atlantic Ocean, abreast of Sheep Pen Hill, Va.:	
Str. Oakdene	11, 277, 1400
Back Creek, Md.:	
Sunken logs	01, 272, 1390
Sunken piles and logs	04, 1274 05, 202, 1147
Back Creek, Va.:	
Str. Norfolk-on-the-Roads	06, 250, 1141 07, 262, 1219
Baltimore H., Md.:	
Sch. W. M. French	89, 115, 942
Sch. Pinafore[8]	93, 147, 1262
Sch. Margaret Kennedy	97, 174, 1307
Sch. Three Brothers	98, 177, 1181
Sch. Fleming	
Sch. Sarah J. Elizabeth	06, 214, 1090
Sl. Potter	08, 239

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[1] Not found.

[2] Removed by U. S. snag boat *Roanoke*.

[3] Removed by U. S. plant and hired labor.

[4] Removed by owners.

[5] Removed by U. S. plant.

[6] Removed by storms.

[7] Removed by gunboat *Vesuvius*.

[8] Removed by ice and waves.

Locality and vessel.	Reports of Chief of Engineers.
Barnegat Inlet, N. J.:	
Str. Mediator	91, 118, 1090
Str. Guadaloup	93, 128, 1183
T. Starlight	
Wreckage	94, 117, 861
Bk. (part of) Charles Loring	10, 255, 1309
Str. Alert	11, 278, 1402
Barnegat Light, N. J., near:	
Sch. George A. Howes [1]	00, 1588
Bass R., Mass., near:	
Sch. O. D. Witherell [2]	95, 69, 710
Sch. Light of the East	95, 70, 710
Bayou La Batre, La.:	
Schrs. P. J. Lyons, M. Fleckas, and J. A. Sprinkler [3]	12, 644, 1949
Bearses Shoal, Mass.:	
Wreckage	95, 71, 720
Beaufort, N. C.:	
Bk. Anna	04, 244, 1505
Beaufort H., N. C.:	
Str. Wave	87, 139, 1098
Beaufort R., S. C.:	
Wreckage [4]	93, 1530
P. b. Sprite	99, 255, 1550
Sch. Leonora	00, 332, 1317
Belle R., Mich.:	
Sch. Albany	08, 742, 2139
Biddeford Pool, Me.:	
Sch. Index	02, 95, 865
Big Pigeon Bayou, La.:	
Str. E. H. Barmore [2]	94, 232, 1383
Black R., Ark.:	
Str. W. J. Bryan [5]	00, 424, 2613
Black R., Mich.:	
Str. Clark	12, 1091, 2676
Black R., N. C.:	
Str. Delta [6]	96, 171, 1144
Black R., Ohio:	
Sc. ——— (dump) [7]	08, 760, 2168
Block Isld. Sound, R. I.:	
Sch. Harry White	94, 82, 711
Wreckage	98, 84, 931
Sch. Merrill C. Hart	10, 112, 1147, 1148
Block Isld., R. I.:	
Sch. Jennie R. DuBois	04, 86, 930
Brg. Nora	
Brg. Montana	07, 94, 954
Sch. Mary A. Randall	12, 135, 1431
Boca Grande Chan., 20 m. w. of Key West, Fla.:	
Sch. Medford [8]	11, 463
Bogue Sound, N. C.:	
Sch. Laura J	89, 147, 1116
Boothbay H., Me.:	
Sch. Harriet W. Babson [9]	03, 53, 727
Boston H., Mass.:	
Sch. Goldsmith Maid	89, 43, 592
Sch. Mary	
Sch. Lillie No. 140120	96, 54, 616
Sc. ——— [10]	03, 88, 785
Str. Kiowa	05, 74, 835, 836
Sch. Chromo	06, 72
Sch. Phineas H. Gay	08, 76, 969
Str. City of Birmingham	08, 77, 970 09, 77, 1002
Sch. Nat. Ayer	11, 91, 1193
Sch. Davis Palmer	11, 91, 1193, 1194
Brandywine R., Del.:	
C. b. Loring Monroe	94, 132, 907 95, 150, 1146
Stone brg. ———	08, 217, 1177
Branford, Conn.:	
Sch. Lizzie D. Saunders	96, 102, 802 97, 138, 1156
Bridgeport H., Conn.:	
C. b. City of Utica	07, 117, 982
L. ———	09, 124, 1054
Towboat Stephen E. Babcock	12, 177, 1463
Sch. Clara Waples	12, 177, 1463
Brigantine Shoal, N. J.:	
Sch. Booth Brothers	93, 1183 94, 117, 861
Str. Cassandra	82, 126, 798 83, 130, 660
Broadkill R., Del.:	
Str. J. I. Van Dorn	87, 96, 847 88, 95, 753
Sch. William D. Rambo	10, 255, 1309
Wreck	10, 255, 1310
Part of wreck	11, 277, 1400
Str. Marie Thomas	12, 326, 1619
Broad Sound, Boston, Mass.:	
Sch. Davis Palmer	12, 102, 1403
Bronx R., N. Y.:	
C. b. ———	93, 105, 1076
C. b. Fox	99, 147, 1278
Brg. B. L. Collar	02, 178, 1039 03, 138, 139, 887
Brg. Bertha Miner	03, 139, 887
C. b. Schroeder & Horstmann	04, 125, 1052
C. b. Louise	04, 125, 1053
C. b. Thomas Mathews	04, 126, 1053, 1054
Brg. Kate	09, 157, 1089
Brooklyn, N. Y.:	
T. William Horre	97, 138, 1158
Br. Narcissus	90, 147, 1278
Browneys Isld., Me., off:	
Sch. Huntress	93, 37, 722
Browns Ledge, Mass., near:	
Wreckage [11]	94, 63, 619
Sch. Harry L. Whiton [12]	95, 70, 718
Wreckage [11]	95, 701
Brunswick H., Ga.:	
Wreckage	93, 231, 1321
Buffalo Bayou, Tex.:	
Brg. No. 3	02, 342, 1391 03, 361, 1347
Dr. boat ———	
Flatboat Daisy	
Buffalo H., N. Y.:	
Brg. Massasoit [13]	05, 627
Bulkhead Bar, Delaware R.:	
Wreckage	96, 122, 938
Buzzards B., Mass.:	
Sch. Annie E. Hayes	89, 55, 641
White Foam [12]	95, 69, 704
Sch. Golden Rule [12]	95, 69, 707
Sch. Maria Adelaide	95, 70, 712
Sch. S. S. Scranton	95, 70, 713
Brg. Baden	07, 94, 958
Calumet R., Ill.:	
T. Macatawa	08, 681, 2002
6 wrecks	09, 718, 2002
Sch. Maryette	10, 795, 2161
Cambridge H., Md.:	
Sch. Two Brothers	89, 111, 905 90, 101, 942
Eldridge [14]	95, 150, 1147
Sch. Coredor [15]	96, 972
Wreckage	00, 229, 1660
Sl. Laure Wilhelmina	01, 272, 1391
Sch. Eldridge	01, 272, 1391 02, 208, 1080
Sl. Ephriam Lyttee	
Sl. Maggie	
Sc. ——— (pile driver)	
Cape Charles:	
Schs. Maria and Elizabeth	86, 159, 970
Sch. Edith Berwind	93, 166, 1344
Sch. Mary E. H. G. Dow	94, 152, 967

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[1] Removed by storms.
[2] Removed by owners.
[3] Removed by U. S. snag boat *Demopolis*.
[4] Not yet removed.
[5] Removed by U. S. and owner.
[6] Removed by U. S. snag boat *H. G. Wright*.
[7] Removed by U. S. dr. *Maumee*.
[8] Believed to be.
[9] Removed by local wreckers.
[10] Drifted away.
[11] Removed by gunboat *Vesuvius*.
[12] Supposed to be.
[13] Removed by city of Buffalo.
[14] Supposed to be.
[15] Removed by Maryland oyster police.

Locality and vessel.	Reports of Chief of Engineers.
Cape Cod, Mass.:	
Str. Perkiomen	86, 80, 618
Sch. J. B. Woodbury	92, 66, 641
Sch. Bertha J. Fellows	
Sch. Annie E. Rudolph, No. 106315	97, 63, 859 98, 69, 883
Cape Fear R., N. C.:	
U. S. gunboat ——[1]	93, 183, 1450
Brg. Clio	86, 175, 1060
Str. North Heath	87, 139, 1098
Sch. George G. Green [2]	94, 168, 1065
Sch. Enchantress	94, 168, 1065 95, 1356 96, 171, 1143
2 wrecks	08, 305
Str. Frye	09, 315
Str. Georgiana	10, 359
Cape Hatteras, N. C.:	
Sch. ——	94, 168, 1065
Cape Henry Light, Va.:	
Sch. A. D. Lawson	98, 201, 1235
Cape Lookout, near:	
3 wrecks [2]	94, 168, 1065
Cape May, N. J., near:	
Brg. Puritan	04, 156
Capes of Delaware, near:	
Sch. Adeline Townsend [3]	09, 224, 1183
Cape Porpoise H., Me.:	
Sch. J. H. G. Perkins	09, 47, 979
Carrabelle R., Fla.:	
Sch. Grace Andrews	04, 321, 1792
T. Bishop	05, 329, 1351
Carters Creek, Va.:	
Bugeye Daisy	02, 218 03, 218, 1071
Cedar Creek, N. J.:	
Sch. I. W. Norris	01, 263, 1352
Sch. Pearsall	04, 177, 1249
Charleston Bar, S. C.:	
Wreckage	90, 141, 1233
Charleston H., S. C.:	
Sch. Kate V. Aitken	93, 189, 1531 94, 174, 1128 95, 198, 1447 05, 270, 1258 06, 292, 1185
U. S. S. Housatonic	08, 323 09, 332, 1316 10, 377, 1457
Bk. Cambusdoon [4]	09, 332, 1315
T. Buck	10, 378, 1457
Anchor .[5]	12, 483, 1809
Charleston to Beaufort, inland passage:	
Raft of logs	00, 291, 1876
Charlevoix H., Mich.:	
Sch. B. Parsons	84, 300, 1995
Chatham, Mass., near:	
Sch. Acacia	94, 62, 611
Wreckage [6]	97, 928
Sch. Emily G. Sawyer	03, 103, 820
Chatham, New H., Mass.:	
Wreckage	99, 81, 1095 00, 93, 1218
Chatham, Old H., Mass.:	
Wreckage	98, 69, 883
Chatham Bar, Mass.:	
Str. Perit	94, 49, 568
Chatham B., Mass.:	
Sch. Charles E. Sears	06, 92, 919
Chatham Beach, Mass., near:	
Sch. Mary J. Castner	95, 70, 709
Chatham H., Mass.:	
Sch. ——	94, 49, 568
Wreckage	98, 69, 883
Sch. Electa Bailey [7]	01, 175, 1147 02, 122, 911

Locality and vessel.	Reports of Chief of Engineers.
Chatham H., Mass.—Continued.	
Bk. Albertina	05, 93, 868, 869
Sch. Frauline	05, 93, 869
Chatham Roads (Old), Mass.:	
Sch. G. M. Farnsworth	94, 63, 613
Wreckage	95, 71, 724
Chehaw R., S. C.:	
Sch. ——	88, 138, 990
Chesapeake B.:	
Clara S.	83, 148, 725
Cascatella	83, 148, 725
Sch. Olephant	84, 151, 948 86, 135, 878 87, 101, 879
Brg. ——	85, 137, 890
Brg. Harry	88, 104, 775
Str. Express	88, 104, 775
Sch. J. W. Knight	90, 101, 942
Sch. Lulu	93, 166, 1344 94, 152, 987
Wreckage	94, 132, 906
Brg. Rose Helen [8]	97, 171, 1289
Sch. Del May	98, 175, 1172
Sch. Walker Armington	98, 201, 1235
Brg. C. C. Chapman	99, 232, 1484
Brg. Washington	
C. b. Hero	00, 234, 1693
Brg. Caravan	00, 264, 1783
Sch. Augustus Palmer	
Brg. Frank Thompson [9]	01, 272, 1391
Dr. ——	01, 298, 1462
Sch. Emblem	
Sch. Ida E. Comley [9]	02, 203, 1080
Brg. Milgendutt [10]	
Sch. E. H. Weaver	04, 227, 1380
Sch. Mary V. Duncan	06, 214, 1090
Raft of piles	
Sch. Amelia M. Price [11]	06, 236, 237, 1124
Sch. Samuel L. Russell [12]	06, 250, 1140
Brg. Oak	06, 250, 1141
Sch. W. H. Van Name	
Sch. Edward Wright	07, 228
Sch. Samuel D. Lankford	08, 239
Str. Emma K.	08, 280, 1275
Sch. J. E. Watkins	09, 247
Sc. ——	10, 281, 1334
Sch. Sunny South	
Sch. J. Dallas Marvil	11, 306, 1431
Sch. Herbert D. Maxwell	12, 362, 1654
Sch. Stella B. Kaplan	12, 420, 1731
Sch. Joseph G. Ray [13]	12, 420, 1732
Chester Creek, Pa.:	
C. b. Frank Dodson	00, 206, 1589 01, 262, 1350 02, 190, 1063
Chicago R., Ill.:	
C. b. China	97, 420, 2881
Sch. John Raber	99, 485, 283, 366
Brg. Robert Howlett	06, 608
Brg. H. A. Richmond	07, 635, 1934
Brg. Atlas	08, 681, 2002
Chicago R., N. Branch, Ill:	
Sl. Peri	07, 635, 1934
C. b. Pallas	08, 681, 2002
Str. Eagle	09, 718, 2003
Sch. S. A. Wood	
L. Hanberg	11, 855, 2372
Chicago R., N. Branch Canal, Ill.:	
Gospel ship A. G. Morey	10, 795, 2161
L. O. J. Hale	
Chicago R., S. Branch, Ill.:	
L. York State	10, 795, 2162
Chincoteague, Va.:	
Sch. Florence I. Lockwood	09, 223, 1182 12, 328, 1618

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[1] Sunk during the Civil War.
[2] Removed by gunboat *Vesuvius*.
[3] Reported not an obstr.
[4] Removed by dr. *Winyah Bay*.
[5] Ex. made, but no wreck found.
[6] Could not be located.
[7] Removed by hired labor.
[8] Removed by wrecking company.
[9] Removed by U. S. tender *Sentinel*.
[10] Removed by owner.
[11] Not an obstr.
[12] Removed by U. S. naval destroyer *Lebanon*.
[13] Destroyed by revenue cutter *Onondaga*.

Locality and vessel.	Reports of Chief of Engineers.
Chincoteague B.:	
Bk. Wolverton	83, 148, 725 84, 151, 948
Chincoteague Lighthouse, Va., near:	
Str. Oakdene [1]	03, 194, 1025
Choptank R., Md.:	
Sl. John Thomas	95, 150, 1147
Sl. Eva Hemingway	89, 111, 905 90, 101, 942
Choptank (Little) R., off Hills Pt., Md.:	
Sch. Virginia S. Lawson	11, 306, 1432
Christiana R., Del.:	
C. b. J. D. Hilton	94, 132, 906
6 wrecks	96, 973 97, 170, 1288
Str. Alice Clark	88, 138, 991
S. b. Delaware	98, 175, 1172
Car float ———	04, 177, 1249
Sailing vessel ———	08, 217, 1176
Brg. ———	08, 217, 1176, 1177
Brg. Elsie	12, 328, 1621
Church Flats:	
Str. Alice Clark	88, 138, 991
Clear Creek, Tex.:	
Brg. ——— [2]	08, 473, 1538
Clearwater H. and Tampa B., Fla., chan. between:	
Dr. Hester [3]	12, 569
Cleveland H., Ohio:	
Sc. ——— [4]	01, 584, 3270
Sch. Horace H. Badger [5]	03, 556, 2105
Str. C. H. Davis [6]	04, 608, 3207
Sch. Algeria	07, 716, 2096
Sch. Lillie	09, 797, 2141
Sch. Shawnee	12, 1110, 2710
Clinton R., Mich.:	
L. ———	07, 685
Cobbs Isld., Va.:	
Sch. Ann R. Rogers	92, 131, 980
Cohansey R., N. J.:	
Brg. Henry C	03, 194, 1024
Sch. Ann Virginia	05, 186, 1123, 1124
Cold Spring Inlet, N. J.:	
Str. Major W. Allen	11, 278, 1403 12, 328, 1618
Colgate Creek, Md.:	
Sc. ———	99, 205, 1410
Columbia R., Oreg.:	
Sh. Sylvia de Grasse	91, 420, 3373 96, 401, 3256 97, 502, 3406 98, 507, 3039 99, 594, 3245 00, 670, 4360
Common Flats, Mass.:	
Wreckage	95, 71, 724
Conneaut H., Ohio:	
Car ferry Chenango No. 1	04, 608, 3209 05, 619, 2368 06, 693, 1921 07, 716, 2096
Connecticut R., Conn.:	
Sl. G. C. Bloomer	87, 55, 636
Sch. R. H. Daly	88, 57, 583
Str. Walontha [7]	06, 114, 940
Sc. ———	12, 177, 1464
Cooper Creek, N. J.:	
C. b. Francis J. Henry [8]	93, 1183
Sc. ———	03, 194, 1024
Cooper Creek, S. C.:	
T. b. F. Huger	93, 189, 1530
Crisfield H., Md.:	
P. Cornelia Ann	99, 202, 1398
Cross Rip Lightship, Mass.:	
Sch. Richard S. Leaming	05, 93, 869

Locality and vessel.	Reports of Chief of Engineers.
Cumberland R., Tenn.:	
Str. W. K. Phillips	01, 463, 2417 02, 302, 1706 03, 417, 1589
Str. Bart E. Linehan	06, 496, 1512 07, 525, 1620 08, 560, 1696
Wharf boat Mayflower	07, 525, 1620 08, 560, 1696
Cumberland Sound, Ga. and Fla.:	
City of Austin	03, 271, 1171
Franconia	04, 279, 1668
Puntalunos	05, 288, 1290
Cuttyhunk Isld., Mass.:	
Sch. Dora M. French	95, 69, 708
Cuttyhunk Pond, Mass.:	
Sch. Quilp	90, 50, 584
Cypress Creek, Va.:	
Sch. Kate Johnson	08, 280, 1276
Darien H., Ga.:	
Str. Molton	92, 180, 1292, 1293
Str. St. Matthews	
Wreckage	97, 237, 538 98, 231, 1320
Dredge No. 14	12, 523, 1846
Davis Strait, Me.:	
Sch. Nevada	98, 52, 838
Deals Isld., Md.:	
Sch. Columbia	00, 229, 1661
Deals Isld. H., Md.:	
Sch. Addie Thatcher [10]	03, 194, 1024
Sch. Little Myro [10]	
Deer Isld. Thoroughfare, Me.:	
Sch. Matilda	98, 52, 838 99, 62, 1049
Delaware B.:	
Sch. Addie Walton	80, 607 81, 822 82, 797
Sch. B. H. Irons	
Sch. E. B. Wheaton	
Sch. Helen Pommell	
Sch. Jessie Wilson	
Sch. J. B. Austin	
Sch. W. A. McGahan	
Sch. M. E. Smith	
Sch. W. G. Dearborn	
Sh. Adolphus	87, 85, 814
Sch. Eureka	87, 85, 813
Sch. Annie S. Gaskell	93, 128, 1183
Brg. McClellan	
Sch. Mount Vernon	94, 862
Str. Allegheny [11]	95, 132, 1078
Sch. Lottie K. Friend	97, 1227 98, 156, 1104 99, 182, 1367 00, 206, 1587 01, 263, 1350 02, 178, 1039 03, 165, 972 04, 157, 1201 05, 163, 1086 06, 176, 1042
Sch. Addie Ludington	00, 206, 1588
Sch. Lavinia Campbell	02, 178, 1040
Sch. Lida Fowler	
Sl. Mary W. Meerwald	03, 165, 971
Sch. Mary E. Insley	
Sch. Milton R. Studhams	
Sch. Reynolds Postles	04, 156, 1200
Brg. Gilberton	04, 156, 1201
Brg. Santiago	05, 163, 1086 06, 176, 1041
Philadelphia City Iceboat No. 3	05, 163, 1086 06, 176, 1042
Brg. Elmwood	06, 176, 1042
Brg. Kalmia	
Sch. Hampton	07, 185, 1104
Sl. Roda and Florence	11, 242, 1365

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[1] Not found.
[2] Removed by snag boat *Capt. C. W. Howell.*
[3] Formerly U. S. dr. *Suwanee.*
[4] Removed by owners.
[5] Removed by storms.
[6] Not an obstr.
[7] Removed by U. S. L. *Panuco.*
[8] Removed by Camden County.
[9] Not yet removed.
[10] Removal not recom.
[11] Removed by owners.

Locality and vessel.	Reports of Chief of Engineers.
Delaware B. and R.:	
Sch. Gen. W. T. Sherman	91, 118, 1090
C. b. Agatha Brady	92, 119, 940
Str. Blanche Henderson	88, 85, 716 89, 101, 875 90, 92, 905
Brg. Casilda	
Sch. David Lee	
Sch. G. H. Bent	
Bk. Il Salvatore	
Bk. Patriot	
Brg. St. Cloud	
Sch. S. C. Morton	
Brg. Tonawanda	
Brg. Wallace	
Brg. Our Little Henry	97, 153, 1227
Delaware Breakwater H., Del.:	
Dr. Potomac [1]	01, 263, 1351 02, 178, 1039
Sch. Sea Bird	04, 156, 1200
Delaware R.:	
Sl. Ann	86, 123, 848
C. b. T. Carroll	
Sch. J. E. Hurst	82, 126, 798
Sch. J. S. Detwiler	84, 138, 850 85, 126, 855
C. b. General Grant	93, 1183 94, 117, 861
Sch. Kent	94, 117, 861
Sch. Enterprise	
Wreckage	96, 122, 938
C. b. Resolute	
Sch. Joseph R. Ellis	99, 182, 1367
Sl. John W. Elliot	99, 182, 1367 00, 206, 1588
Sch. Clara	00, 206, 1589
C. b. Victory	00, 206, 1589
C. b. James McNeal	
Sch. Mary Baxter	01, 263, 1352
Brg. Iron State	01, 262, 1351
2 wrecks	
C. b. H. C. Webster	02, 178, 1040
C. b. Beaver	
Brg. Harry E. Bird	03, 165, 971
Sch. Annie Cooney	04, 156, 1200
Sc. ——— (pile driver)	
Brg. Alice	04, 156, 1201 05, 163, 1085, 1086 06, 176, 1041 07, 185, 1103 08, 193, 1142
Pontoon	06, 176, 1042, 1043 07, 185, 1103, 1104
Coal sc	06, 177, 1043
C. b. ———	
C. b. ———	07, 185, 1104
Houseboat ———	08, 193, 1142 09, 198, 1152
Brg. Alfred	08, 193, 1142
Sch. Eden	08, 193, 1142 09, 198, 1152
Sch. John A. Lingo	09, 198, 1153
Brg. Admiral Clark	11, 242, 1365
T. James Herron	
Sc. Joe Herron	
Sch. Howard W. H. Taylor [2]	
Brg. Estella	12, 289, 1579
Brg. Tragic	12, 289, 1579
Sch. Eugene H. Cathrall	12, 289, 1577
Dennis Creek, N. J.:	
Sch. Druzilla B. Lee	00, 206, 1589 01, 262, 1350
Sch. Irene A. B. Crawford	02, 190, 1063
Detroit R., Mich.:	
Sch. Sweetheart	82, 298, 2375
Str. Nile	83, 306, 1886
Sch. Leader	01, 570, 3198
Detroit R., Mich.—Continued.	
Brg. Richard Martini	05, 601, 2288 06, 676, 1921
Sch. City of Toledo	07, 698, 2057
Sch. Montpelier	08, 742, 2139
Sch. John Schuette	10, 859, 2281
T. Louise [3]	
Sch. Maria Martin	10, 2282 11, 914, 2476
Dividing Creek, N. J.:	
Sl. Lydia	11, 278, 1402
Dorchester B., Boston H., Mass.:	
Sch. Sceneby	12, 102, 1404
Duluth H., Minn.:	
Str. Winnipeg	98, 385, 2287
T. E. P. Ferry	01, 514, 2883 02, 438, 2042
Str. Thomas Wilson	02, 2042 03, 1828
Dutch Isld. H., R. I.:	
Sch. Davis Brothers	93, 69, 851
Duwamish R., Wash.:	
Br. Atlas	08, 849
Eagle H., Wis.:	
Str. Cecelia Hill	09, 706, 1986
East Chester B., N. Y.:	
Sc. ———	09, 156, 1089
East R., N. Y.:	
U. S. engineer dr. Flood Rock	94, 95, 785 95, 120, 998 96, 109, 869
Brg. Milton	94, 95, 786 95, 120, 998
C. b. ———	00, 1422
Sl. Pell	03, 139, 887
C. b. ———	04, 126, 1053
Pile driver ——— [4]	07, 145, 146, 1019, 1020
Str. Malvina St. Clair	07, 146, 1020
Sch. H. T. Hedges	09, 157, 1089
Sch. Long Island	11, 183, 1283
C. b. Jamaica	11, 184, 1285
C. b. ———	12, 223, 1501
Brg. Frank Miller	11, 184, 1285
Eatons Neck Lighthouse, Long Isld. Sound:	
Sch. Clara E. Simpson	95, 93, 850
Edgartown H., Mass.:	
Sch. ———	93, 70, 857
Edgartown, Marthas Vineyard, Mass.:	
Yacht Senta	11, 117, 1218
Elizabethport, N. J.:	
Brg. Nellie	91, 107, 1013
Elizabeth R., N. J.:	
3 C. b. ——— [5]	94, 108, 828
Brg. Antoinette Fisher [5]	03, 159, 955
Elizabeth R., Va.:	
Str. Helen Smith	97, 198, 1380 98, 201, 1234
Sch. Henry Lippitt	95, 1295 96, 159, 1084 97, 198, 1379 98, 159, 1084
Sch. John C. Haynes	96, 159, 1084 97, 198, 1379 98, 159, 1084
Sch. Maggie	98, 159, 1084
F. b. Manhassett	00, 264, 1783
Wrecked cars	00, 264, 1784
Brg. East New Market	02, 226, 1126
Brg. Centennial	
Brg. ———	11, 350, 1511
Elk R., Md.:	
Brg. J. E. Gillingham [6]	98, 175
Brg. William E. Weller	99, 182, 1367
Sunken piles and logs	04, 1274 05, 202, 1147

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[1] Removed by owners.

[2] Removed from chan. by U. S. plant and raised by owners.

[3] Removed by private parties.

[4] Not found.

[5] Removed by owners.

[6] Disappeared in the mud.

Locality and vessel.	Reports of Chief of Engineers.
Elk R., Md.—Continued.	
Sch. Sallie Ann	11, 306, 1432
Str. Lizzie Hunt	12, 362, 1654
Erie H., Pa.:	
Sc. Pacific	96, 376, 3127
T. Annie Laurie	97, 472
T. Sheldon Bros	11, 2510
Fairhaven H., Mass.:	
Sch. Francis Edwards	93, 69, 851
Fairport H., Ohio:	
Sch. J. J. Hill	86, 339, 1876
Part of timber crib	04, 608, 3207, 3208
Brg. L. L. Lamb [1]	03, 556, 2106 04, 607, 3206, 3207 05, 618, 2367
Yacht Idler [1]	04, 608, 3208, 3209 05, 618, 2367
Fenwicks Isld. Light, Del., near:	
Str. Sutton	03, 194, 1026 04, 193, 1274
Flint R., Ga.:	
Str. Mascot	01, 363, 1793 02, 293, 1280
Flushing Creek, N. Y.:	
Brg. Helen R	10, 179, 1213
Flynns Knoll, N. Y.:	
Brg. David Crockett [2]	99, 147, 1278
Fort Hamilton, N. Y.:	
Str. Ailsa	97, 114, 1039
Fort McHenry, Md.:	
Sch. Margaret Kennedy	97, 174, 1307
Frankford Creek, Pa.:	
C. b. Daisy	04, 156, 1200
Brg. ———	12, 289, 1577
Frankford, Me.:	
Sch. Swan [3]	97, 43, 801
Galveston B., Tex.:	
Str. Cumberland	01, 411, 1959 02, 342, 1390
Brg. Jules	
Brg. Alice	
T. Kate	
Boats, beacons, and bridges [4]	05, 399, 1516 06, 429, 1351 07, 450
Ophelia (vessel) [4]	06, 1351 08, 473, 1538
Lady Dora [4]	
Brg. No. 3 (oil)	
Galveston H., Tex.:	
Str. City of Waco	99, 345, 1972 00, 394, 2341
Dr. No. 3	02, 342, 1391 03, 361, 1347
Brg. Swearingen [5]	10, 558, 1659
Gay Head, Mass.:	
Sch. Josiah R. Smith	95, 71, 725
Sch. Josiah Whitehouse	91, 61, 732
Gedney Chan., N. Y.:	
T. Talsiman	94, 95, 785
Brg. Andrew Jackson	96, 109, 869 97, 114, 1039
Glen Cove H., N. Y.:	
Sch. Superior	11, 209, 1314
Gowanus Canal, N. Y.:	
T. William Horre (see Brooklyn, N. Y.)	97, 138, 1158
Grand Lake, La.:	
Str. Queen of the West	95, 259, 1782 96, 225, 1520
Grand Marais H., Mich.:	
Str. A. A. Parker [6]	04, 517, 2781, 2782
Grand R., La.:	
Str. G. W. Anderson	94, 232, 1383

Locality and vessel.	Reports of Chief of Engineers.
Grand R., Ohio:	
T. McCormick	07, 716, 2096 08, 760, 2168
Grassy Sound, N. J.:	
Dr. Townsend	12, 328, 1619
Great Chazy R., N. Y.:	
C. b. F. W. Avery	08, 76, 970
Great Egg H. Inlet, N. J.:	
Sch. Marcia S. Lewis	93, 128, 1182
Sch. Palestine	97, 153, 1227
Sch. Alice Bell	
Great Pedee R., S. C.:	
Confederate gunboat	09, 333, 1317 10, 377, 1457 11, 398, 1589
Great Pt. Rip, Mass.:	
Wreckage [7]	95, 712
Sch. Julia E. Pratt	95, 70, 715
Great Salt Pond H., R. I.:	
Brg. Montana	07, 94, 954
Great South B., N. Y.:	
Sch. ——— [8]	05, 134, 990
Sl. ——— [9]	07, 145, 1019
Wreck ———	10, 180, 1214
Green B., Wis.:	
T. J. W. Bennett	07, 624, 1915
Str. Cecelia Hill	09, 706, 1986
Green B. H., Wis.:	
Str. City of Glasgow	08, 669, 1988
Greenport H., N. Y.:	
Sch. Doretta Kahn	04, 125, 1052
Sch. Saucy Maid	
Sch. Chief Justice Dailey	
Sch. S. P. Bogart	
Sch. Arabella	
Sch. Jennie	
Sch. ———	
Green Run Lightship Station, Md., near:	
2 wrecks	02, 190, 1068
Green Run Inlet, Md., near:	
Sch. Elsie M. Harris	03, 194, 1028
Gulf of Mexico, entrance to Withlacoochee R., Fla.:	
Br. Zoradia	12, 568
Habana H., Cuba:	
U. S. battleship Maine	10, 5 11, 1119, 2089 12, 1344, 2565
Hackensack R., N. J.:	
C. b. ———	11, 233, 1347
Hampton Creek, Va.:	
Sch. R. L. Loper	00, 264, 1784
Sch. Three Sisters	07, 263, 1219
5 wrecks	12, 420, 1732
Hampton Roads, Va.:	
Bk. E. L. Pettingill	89, 120, 963 90, 108, 1029
Sch. Willie Lee Hall	03, 228, 1068 04, 227, 1380
Brg. John R. Zimmerman	07, 262, 1219
Sch. Bismarck	09, 288, 1271
Sch. Wm. Henry	10, 328, 1398
Handkerchief Lightship, Mass.:	
Sch. Benjamin Gartside	90, 50, 586 91, 61, 731
Handkerchief Shoal, Mass.:	
Sch. Sarah Potter	03, 103, 820 04, 86, 929
Sch. M. C. Haskell	06, 92, 919
Hardings Beach, Mass.:	
Sch. Anna Laura	05, 93, 869
Harlem R., N. Y.:	
C. b. ———	88, 67, 637
C. b. Gettysburg	00, 159, 1421
C. b. ———	05, 134, 989, 990
Sch. ———	

[1] Removed by U. S. dr. *Maumee.*
[2] Not yet removed.
[3] Supposed to be.
[4] Removed by U. S. dr. *Gen. S. M. Mansfield.*
[5] Removed by U. S. derrick brg. No. 1.
[6] Not an obstr.
[7] Could not be located.
[8] Removed by U. S. str. *Sentinel.*
[9] Removed by hired labor.

Locality and vessel.	Reports of Chief of Engineers.
Harlem R., N. Y.—Continued.	
T. Sea Wall	07, 146, 1021
Sch. Deborah T. Hill	08, 154, 1071
C. b. General	11, 184, 1284
Hempstead H., N. Y.:	
Str. Bay Ridge	89, 70, 733 90, 62, 667
C. b. Thomas Tryon [1]	07, 146, 1020
Hen and Chicken Lightship, Mass.:	
Brg. Fidelia	04, 86, 929
Henderson H., N. Y.:	
C. b. ——	97, 482, 3304
Hereford Inlet, N. J.:	
Str. Gulf Stream	09, 224, 1183
Sch. ——	12, 328, 1621
Hereford Lighthouse, N. J.:	
Sch. Marion F. Sprague	96, 122, 938
Hillsboro B., Fla.:	
Str. Kissimmee (boilers of)	02, 281, 1225
Sch. Eugene Barty	08, 368
Hillsboro R., Fla.:	
L. ——	97, 251, 1566
Brgs. and sunken timber	06, 331, 1240
Sc. —— [2]	07, 347
Logs [2]	
Piles	08, 369
Phosphate dr	09, 384
Logs, etc	09, 385
Sch. Lily White	11, 462
Hilo H., Hawaii:	
Bk. Martha Davis	06, 790, 2052
Hog Isld., Va.:	
Sch. Harvey W. Anderson	92, 131, 980
Hoopers Strait, Md.:	
Sch. Mary Liz Thomas	12, 362, 1653
Horn Isld. H., Miss.:	
Bk. Hilja [3]	04, 342, 1839 05, 353, 1428
Hudson R.:	
C. b. ——	83, 100, 556
Sl. Locomotive	88, 67, 637
F. b. New Brunswick	97, 114, 1039
C. b. Hager Johnson	
T. W. R. Sheffield	99, 163, 1315
C. b. McDonald	
Deck load of stone	
Sl. Pacific	00, 187, 1517
C. b. R. G. Fairbanks	00, 187, 1516
Str. W. M. Whitney	99, 163, 1316 00, 187, 1516
L. Union	01, 223, 1248
C. b. Alert	03, 139, 887
Wreck ——	03, 139, 888
Brg. Jas. Cogswell	
C. b. ——	04, 125, 1052
Brg. H. L. Higgins	04, 125, 1053
C. b. Andrew Grant	04, 126, 1054
C. b. —— [4]	
C. b. ——	05, 140, 1024
Brg. Percie and Bertha	05, 134, 989
Sch. Eaglet	07, 145, 1019
T. Sharp	
Brg. Coggeswell	
Brg. Charles G. Hill	07, 146, 1021
F. b. Paterson	07, 146, 147, 1022 08, 153, 1069, 1070
C. b. Mamie Doherty	07, 147, 1022 08, 153, 1070
C. b. D. & H. No. 3079 [5]	08, 154, 1071
Brg. ——	09, 157, 1090 10, 179, 1212
Sch. Winslow Morse [6]	
Brg. Bessie	
Sc. ——	10, 179, 1213
Wreck	10, 180, 1213
Wreckage	
Float ——	11, 183, 1282
Hudson R.—Continued.	
C. b. Bertha	11, 183, 1282
C. b. George Chambers	11, 183, 1286
C. b. ——	11, 193, 184, 1284
C. b. Elsie	11, 184, 1286
C. b. ——	
C. b. ——	
C. b. Calcutta	12, 223, 1499
Landing float ——	
C. b. ——	12, 223, 1500
C. b. Perty	
C. b. Annie Big	12, 223, 1502
Sc. ——	
Huron H., Ohio:	
T. Osceola [7]	10, 878, 2301
Hyannis H., Mass.:	
Sch. S. S. Bickmore	91, 62, 732
Sch. Annie W. Akers	94, 63, 614
Sch. Stephen Raymond	94, 63, 615
Sch. Katie Mitchell	94, 63, 616
Sch. Robert Mowe	96, 69, 665
Sch. Melinda Wood	99, 96, 1145
Sch. Thomas Borden	03, 103, 819
Sch. Alice T. Boardman	08, 96, 995
Illinois R. (see Removal of snags):	
Wreck	09, 553, 1617
Inland passage, Charleston to Beaufort, S. C.:	
Sunken logs	01, 324, 1607 02, 251, 1173 03, 257, 1140
Inland waterway of New Jersey:	
Brg. Saratoga	12, 328, 1620
Jackson Creek, Md.:	
Sch. Maria Green	91, 131, 1201
Wreckage [8]	96, 972
Sch. Harry Moore [9]	01, 272, 1391
James R., Va.:	
Str. Wyanoke	98, 200, 1234
Bk. J. D. Bischoff	06, 250, 1140 07, 249, 1199 08, 263, 1251, 1252
Dr. City of Richmond	
Sch. Curtis W. Wright	08, 280, 1276
Sch. ——	
Sl. Haze [10]	09, 288, 1271
Sl. —— [11]	10, 307, 1374
Sch. W. S. Rodgers	11, 330, 1482
Sl. ——	
T. Col. J. C. Hill	12, 420, 1730
Brg. ——	
Judith Pt., R. I.:	
Brg. ——	95, 71, 723
Kennebec R., Me.:	
Lavina Bell	99, 62, 1049 00, 62, 1100
Sch. Henry L. Peckham	11, 61, 1163
Sch. Young Brothers	
Kewaunee H., Wis.:	
T. James N. Brooks	07, 624, 1916
Sch. Edith H. Koyen	
Sch. Exchange	
Brg. Liberty	
Unknown vessel	
Keyport H., N. J.:	
Sch. G. W. Van Cleaf	00, 187, 1517
Key West H., Fla.:	
Bk. Marcello	96, 198, 1338 97, 251, 1566 98, 245, 1343
Bk. Brandon	
Bk. Auto	
Bk. Almora	
Sch. Adelaide Baker	
Sch. Rosalie	
Sh. Marie Frederika	
Str. Cochran	
Old dry dock	
Str. Governor Marvin	97, 251, 1566

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[1] Removed by hired labor.
[2] Removed by U. S. dr. and snag boat *Suwanee*.
[3] Removed by U. S. and owners.
[4] Floated away.
[5] Owner remitted cost of removal.
[6] Assumed. Locality not stated.
[7] Removed by U. S. dr. *Maumee*.
[8] Removed by Chester R. Steamboat Co.
[9] Removed by U. S. tender *Sentinel*.
[10] Removed by private parties.
[11] Not an obstr.

Locality and vessel.	Reports of Chief of Engineers.
Key West H., Fla.—Continued.	
Bk. Ceres	02, 273, 1216
Str. O. C. Williams	03, 281, 1187
Sch. Cottrell	
Sc. (3)	
Propeller [1]	06, 331, 1240
Sch. Frederick W. Alton	10, 434
T. G. W. Childs	12, 586
Sch. Heartsease	
Kill Pond Bar, Mass.:	
Sch. Asia	99, 96, 1144
Brg. Excelsior	98, 84, 932 99, 96, 1144
Kill Van Kull, N. Y. and N. J.:	
Str. Canonicus	95, 120, 998
C. b. Geo. H. Notter	07, 174, 1077
Kill Van Kull, N. J.:	
Sch. Chrystal	08, 183, 1118, 1119
Lake St. Clair, Mich.:	
Lighthouse cribs	04, 3139
T. Fannie Tuthill	06, 676, 1891 07, 698, 2057
U. S. str. Hancock	06, 676, 1891
Lake Champlain:	
C. b. (8) or parts of	03, 73, 753
C. b. Anna Weightman	05, 74, 836
C. b. Russell Wright	
C. b. Julius Fulton, jr	
C. b. E. M. Wright & Co.[2]	06, 72
C. b. (8)	09, 77, 1003 10, 88, 1121
C. b. Geo. D. Cull	10, 88, 1121
C. b. John R. Myers	
C. b. North Star	
C. b. E. D. Case	
C. b. Richmond	
C. b. William Parker	10, 88, 1121
C. b. F. J. Bailey	
C. b. Governor Roosevelt	
C. b. Georgie T	
C. b. Armenia Allore	
Str. Germania	
Str. Reindeer	
C. b. Folsom	10, 88, 1121 11, 183, 1280
C. b. A. Gravel	
C. b. Thompson	
C. b. Thos. F. Quinn	
C. b. R. A. Bullis	
C. b. Damon	
C. b. Alec Black	10, 88, 1121 11, 183, 1281
C. b. Saunders	
C. b. ———	
C. b. Jamson	11, 183, 1281, 1282
C. b. Clara	
C. b. Una	
Lake Erie:	
Sch. Benson	00, 603, 4094
Sch. Laura Miller	00, 603, 4095
Sch. H. G. Cleveland	00, 603, 4096
Sch. Dundee	01, 584, 3269
Str. George Dunbar	03, 556, 2103
Str. Lockwood [3]	04, 607, 608, 3207
Str. Queen of the West [4]	04, 608, 3208
Spar	05, 627
Str. Iron Age	09, 780, 2120 10, 859, 2281
Sch. Spademan	10, 878, 2301
Str. W. C. Richardson	12, 1125, 2733
Lake Huron:	
— D. M. Wilson [5]	95, 395, 2841
Brg. Checotah [6]	07, 698, 2057, 2058
Sch. or brg. ——— [7]	08, 742, 2139
Str. Eliza H. Strong	08, 742, 2139 09, 780, 2119 10, 859, 2280

Locality and vessel.	Reports of Chief of Engineers.
Lake Michigan, Wis.:	
Sch. Kate Kelly	95, 367, 2681 96, 323, 2560
Lake Michigan, Ill.:	
Brg. No. 2 (car ferry)	08, 681, 2002
Sch. David Dows	09, 718, 2002
Hydraulic dr	09, 718, 2003
Lake Monroe, Fla.:	
Str. Starlight [8]	05, 309, 1320 06, 331
Lake Ontario:	
Anchored spar [9]	03, 575, 2169
Lake Pontchartrain, La.:	
Sch. A. J. Ramsay	10, 528, 1627
Lake Superior, Mich.:	
Str. Hutchinson	04, 517, 518, 2782
Str. Alex Nimick	08, 647, 1938 09, 683, 1939 10, 757, 2094 11, 813, 2298, 2299
Str. Sevona [10]	09, 683, 1940 10, 756, 2094
Str. Chauncey Hurlbut	10, 757, 2095
Str. Manhattan	11, 813, 2299, 2300
Leipsic R., Del.:	
Sch. Mint	95, 150, 1146
Sch. Jas. K. Burnite [9]	03, 194, 1025 04, 178, 1248
Lewes Creek, Del.:	
Sl. Glide	12, 328, 1619
Lexington, Mich., near:	
Str. Eliza H. Strong [11]	06, 663, 664 07, 698, 2057
Little Creek, Del.:	
Sch. Mary L. Bird	00, 229, 1660
Sch. Van Sciver	03, 194, 1023
Sl. Nettie	
Sch. Carrie	12, 328, 1621
Little Egg H. Inlet, N. J.:	
Sh. Parkfield	84, 138, 850 85, 126, 856
Sh. Francis	98, 156, 1104
Sch. Rebecca M. Smith	05, 186, 1122, 1123
Little Egg H. B., N. J.:	
Brg. Carrie	04, 178, 1249 05, 186, 1122
Little H., Woods Hole, Mass.:	
Sch. Ellen R	90, 50, 584
Little Red R., Ark.:	
Coal brg. ———	00, 424, 2613
Little Rock, Ark.:	
Str. Eli	95, 286, 2037 96, 248, 1696
Locklies Creek, Va.:	
Bugeye [9]	10, 307, 1373
Logstown, Pa.:	
4 coal boats	94, 289, 1889
Long Isld. Sound:	
Sch. E. J. Higgins	88, 57, 584
Sch. Louisa Bliss	
Sch. Lizzie Raymond	94, 82, 714
Sch. Eliza Anderson	94, 82, 712
Wreckage [12]	95, 721
Sch. Clara E. Simpson	95, 93, 850
Sch. Richard Hall [13]	99, 141, 1251 00, 159, 1421
Sch. Buena Ventura [14]	07, 117, 982
Sch. ———	09, 157, 1090
Longport, N. J., point of beach:	
Piling	11, 278, 1403
Lorain H., Ohio:	
Str. Quito [9]	03, 556, 2104
Lower New York B., N. Y.:	
Brg. Andrew Jackson	96, 109, 869

[1] Not found.

[2] Removed at private expense.

[3] Not an obstr.

[4] Removed by U. S. t. *Quest*.

[5] Removed by ice and waves.

[6] Spar of, removed by U. S. t. *Johnson*.

[7] Removed by U. S. str. *Hancock*.

[8] Removed by U. S. snag boat *Florida*.

[9] No obstr.

[10] Part removed by owners and part by U. S. str. *Vidette*.

[11] Removed by underwriters.

[12] Removed by strong tide or currents.

[13] Removal incomplete.

[14] Destroyed by revenue cutter *Mohawk*.

Locality and vessel.	Reports of Chief of Engineers.
Lynn H., Mass.:	
Sch. Ellen Maria	00, 77, 1169
Lynn Haven H.:	
Sch. Anthea Godfry	86, 159, 970
Mackey Creek, N. C.:	
Logs [1]	09, 288, 1271
Mackinac Straits, Mich.:	
Brg. Richard Winslow	02, 494, 2244 03, 542, 2046
Mahon R., Del.:	
Sch. Malvina	02, 190, 1063
Manhasset B., N. Y.:	
Bk. Hoppet	95, 93, 852
C. b. 2 ——	96, 102, 801
Manitou (South) H., Mich.:	
Sch. Margaret Dall	11, 885, 2414
Manitowoc H., Wis.:	
Str. (ferry) Ann Arbor No. 1	12, 1004, 2534, 2535
Man of War H., Fla.:	
Wrecks (designated as) Nos. 9, 10, 11, 12, 13 (Florida), 14, 15 (Cora's boiler)	97, 251, 1566 98, 245, 1343
Old stern dock [2]	09, 385
Manokin R., Md.:	
Sch. Wm. H. Roach	00, 229, 1661 01, 272, 1390
Mantua Creek, N. J.:	
Brg. Homeward Bound	09, 224, 1183
Marblehead Light, Ohio, near:	
Str. City of Concord [3]	07, 716, 2096
Sch. Wm. Crosthwaite [4]	
Marcus Hook Ice H., Pa.:	
C. b. M. P. Howlett	04, 156, 1200
Mare Isld. Straits, Cal.:	
Sch. Witch of the Bay	07, 749, 2151
Marine City, Mich.:	
Float [5]	03, 2047
Marsh R., Me.:	
Sch. Old Swan	97, 43, 801 00, 62, 1100
Marthas Vineyard, Mass.:	
Sch. Mary B. Smith	98, 84, 931
Mattaponi R., Va.:	
Sl. ——	88, 116, 845
Sc. ——	
Sch. ——	
L. Exertion [6]	04, 217, 1342
Mattituck Creek, N. Y.:	
Sc. ——	12, 253, 1528
Maumee B., Ohio:	
Sch. Ferrett	96, 368, 2972
Floating crib [7]	03, 557, 2106
Maurice R., N. J.:	
Brg. ——	83, 130, 660
Sch. Trade Wind	
Sch. Anna Maria	98, 156, 1104 99, 182, 1367
C. b. May	00, 206, 1589
Sl. Gertrude	04, 177, 1249
Sl. Constitution	04, 178, 1249 05, 186, 1121, 1122
Sch. Baltimore	11, 277, 1401
Mayaguez H., P. R.:	
Sch. Frank T. Stinson	11, 1062, 2656
Sch. Mary B. Pierce	12, 1275, 2878
L. Indie	
Michigan City H.:	
Str. Horace A. Tuttle	99, 504, 2951 00, 568, 3933
Millbridge, Me.:	
Sch. L. Holoway	97, 42, 798 98, 52, 838

Locality and vessel.	Reports of Chief of Engineers.
Milwaukee B., Wis.:	
Brg. Sumatra	97, 407, 2751
Sch. Hiram R. Bond	05, 543, 2063
Milwaukee R.:	
Sch. Contest	99, 473, 2812
Mishaum Pt., Mass.:	
Sch. S. S. Scranton	95, 70, 713
Mispillion R., Del.:	
T. Charles Lea	93, 143, 1228 94, 132, 906
Sc. ——	04, 178, 1249 05, 186, 1121
Mississippi R. (see Removal of snags):	
Str. Albert S. Willis	95, 287, 2043
Br. 2—coal	
Str. Hudson	96, 23, 249, 1707
Brg. ——	97, 23, 317, 2001
Str. Golden City	98, 309, 1687
Str. Dolphin No. 2	
Brg. ——	
Mississippi R., above Missouri R. (see Removal of snags):	
3 wrecks [8]	02, 370, 1609
Boilers of str. Ravenna [9]	03, 393, 1467
Brg. —— [10]	08, 1628
Wreck	09, 553, 1617
Mississippi R., below Missouri R. (see Removal of snags):	
Dr. New Era [11]	01, 434, 2167
Brg. —— [11]	
Str. Howard [11]	
Yacht Signia [11]	
2 brgs. [11]	
7 wrecks [12]	02, 366, 1593
Str. Eagle	03, 389, 390, 1442
C. b. —— [13]	05, 423, 1584
Str. Jim Lee [13]	
Str. Robert E. Lee [13]	
2 derrick boats [13]	
4 brgs. [13]	
Old wreck [13]	
Brg. —— [13]	
Str. Emma Etheridge [13]	
Traction engine [14]	06, 461, 1399
Str. Fred Nellis [15]	
Sand dr. Colorado	
Str. City of St. Louis [16]	06, 461, 1399 08, 519, 1610
Str. Frank [17]	06, 461, 1399
Str. Iona [14]	08, 519, 1610
7 wrecks [13]	07, 486, 1535
4 brgs. [16]	08, 519, 1610
Machinery of str. Currin [16]	
Boilers and machinery of str. Moran [14]	
3 brgs. [14]	
Machinery of str. Frank [14]	
Machinery of U. S. pile driver [14]	
23 wrecks [17]	09, 549, 1594
Missouri R. (see Removal of snags):	
2 launches [18]	08, 546, 1665
Boilers of str. Susan [18]	08, 546, 1667
59 miscellaneous obstrs. [18]	08, 546, 1669
Str. Uncle Sam	11, 705, 2022
Mobile B., Ala.:	
Brg. Goodwin	05, 353, 1428 06, 380
Old dry dock	06, 380
Mobile H., Ala.:	
Dr. Jumbo [19]	04, 342, 1839

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[1] Removed by snag boat *Roanoke*.
[2] Removed by hired labor and leased plant.
[3] Removed by U. S. str. *Visitor*.
[4] Removed by U. S. dr. *Maumee*.
[5] Removed by U. S. str. *Hancock*.
[6] Removed by hired labor and U. S. snag boat.
[7] Owners paid for removal.
[8] Removed by U. S. dr. *Phoenix*.
[9] Removed by U. S. snag boat *Col. A. Mackenzie*.
[10] Removed by U. S. snag boat.
[11] Removed by U. S. snag boat *Horatio G. Wright*.
[12] Removed by U. S. snag boats.
[13] Removed by U. S. snag boats *H. G. Wright* and *J. N. Macomb*.
[14] Removed by snag boat *H. G. Wright*.
[15] Aground; pulled off by snag boat *H. G. Wright*.
[16] Removed by U. S. snag boat *Macomb*.
[17] Passengers rescued by snag boat *H. G. Wright*.
[18] Removed by snag boats *Missouri*, *James B. McPherson*, and *Mandan*.
[19] Removed by U. S. plant.

Locality and vessel.	Reports of Chief of Engineers.
Mobile R., Ala.:	
Brg. New York	84, 206, 1217
Br. Uncle Sam	
Str. Gertrude	
Dry dock	93, 237, 1782 94, 219, 1332 95, 243, 1712 07, 394, 1397 08, 420, 1454 09, 438, 1437
Sc. ——	99, 317, 1784
Brg. —— [1]	00, 359, 2223
Sch. Fleet Wing	01, 378, 1853
Several pontoons [2]	03, 324, 1272
Brg. Black Diamond	10, 488, 1588
Mobjack B., Va.:	
Brg. ——	12, 390, 1696
Monomoy, Mass.:	
Sch. ——	93, 70, 859
Sch. Charlotte Fish	93, 69, 855
Sch. J. B. Woodbury	93, 69, 849
Sch. Bertha J. Fellows	93, 69, 850
Bk. R. A. Allen	93, 69, 854
Sch. Royal Arch	95, 70, 719
Sch. Ellen Morrison	95, 70, 716
Brg. Oneonta	95, 71, 726
Monomoy Beach, Mass.:	
Sch. Asa H. Pervere	94, 63, 618
Bk. Harriet S. Jackson [3]	99, 1094
Monomoy Isld. (w. side), Mass.:	
Sch. A. G. Cole	12, 135, 1430
Monomoy Life-Saving Station:	
Sch. Nellie V. Rokes	93, 70, 859 94, 62, 607
Monomoy Pt., Mass.:	
Sch. Rogers	93, 70, 859 94, 62, 608
Sch. Ocean Traveler	94, 62, 606
Sch. Wm. Wilson	96, 70, 666
Sch. James G. Blaine	03, 103, 820
Sch. Connecticut	04, 86, 930
Monomoy Pt. Lighthouse:	
Sch. Franklin	94, 63, 616
Sch. Laura E. Messer	94, 63, 617
Monroe B., Va.:	
Brg. Laurel	07, 249, 1199
Monroe H., Mich.:	
Dr. ——	98, 452, 2687 99, 536, 3075
Wrecks —— [4]	02, 506, 2294
Moosabec Reach, Me.:	
Sch. Huntress	92, 39, 533
Muskeget Chan., Mass.:	
Sch. St. Thomas	03, 103, 819
Nansemond R., Va.:	
Sch. Terry Not	86, 159, 970
Nantucket H., Mass.:	
Sch. ——	93, 70, 856
Sch. Julia E. Pratt	95, 70, 715
Sch. Frank Palmer [4]	05, 93, 869
Nantucket Isld., Mass.:	
Sch. Nettie B. Dobbin	10, 112, 1148
Nantucket Light, Mass.:	
Sch. Andrew J. York	92, 65, 638
Nantucket Shoals, Mass.:	
Sch. Dora Mathews	03, 104, 820
Sch. Agnes E. Manson	
Nantucket Sound, Mass.:	
Sch. John P. Kelsey	94, 62, 612
Sch. Lucy Jones	92, 65, 638
Sch. Allie Oakes	
Sch. Edith T. Gandy	92, 66, 640
Steam yacht Alva	94, 62, 604
Wreckage	95, 71, 724
Wreckage [5]	95, 712
Sch. Light of the East	95, 70, 710
Sch. Fannie Flint	99, 96, 1145
Bk. Bonnie Doon	07, 94, 953
Sch. Harry Messer	09, 99, 1024
Sch. Jennie French Potter	09, 100, 1024 10, 111, 112, 1146, 1147
Nantucket Sound, Mass.—Contd.	
Sch. Mary Farrow	11, 117, 1218
Sch. Lois V. Chaples	12, 135, 1431
Sch. Hannah F. Carleton	
Napa R., Cal.:	
L. No. 1	08, 797, 2229
Narragansett B., R. I.:	
Sch. Mott Haven	86, 81, 619
Sch. Willie De Wolf	
Sch. Addie M. Anderson	99, 96, 1145
Narraguagus B., Me.:	
Sch. L. Holway	97, 42, 798 98, 52, 838
Nauset H., Mass.:	
Wreckage	01, 159, 1091
Sch. Ira Laffrinier [6]	02, 108, 886 03, 88, 785
Sch. Mondego	02, 108, 886
Sch. Maud Briggs[6]	03, 88, 785
Nauset Life-Saving Station, Mass.:	
Sch. Mary A. Heaton	96, 70, 666
Naushon Isld., Mass.:	
Sch. Golden Rule[7]	95, 69, 707
Sch. E. K. Hart	95, 70, 714
Nebish (west) Chan., Mich.:	
Str. John B. Ketcham [8]	10, 859, 2282
Newark B., N. J.:	
C. b. Harwick	98, 144, 1072
C. b. Katie Watson	00, 187, 1516
C. b. W. B. Hurd	00, 187, 1516
C. b. ——	02, 177, 1038
C. b. ——	03, 158, 954
C. b. F. D. Tower	
C. b. (2) ——	03, 159, 955
C. b. ——	04, 148, 1157
C. b. ——	06, 167, 1019
C. b. ——	10, 211, 1254
C. b. ——	
Newburyport H., Mass.:	
Sch. J. E. Sanford	90, 37, 516
Sch. Ocean Eagle	95, 53, 642
Sch. Julia A. Dicker	08, 76, 969
New Haven H., Conn.:	
Sch. June	85, 95, 709
Sch. Eliza Anderson [1]	94, 82, 712
Sch. Geo. Hotchkiss	95, 93, 851
Sch. Eclipse	08, 121, 1030
Sch. Menawa	09, 124, 1054
Newport H., R. I.:	
Sch. Charles W. Morse	99, 96, 1145
Newport News, Va.:	
Str. Wyanoke	97, 198, 1379 98, 200, 1234
New Orleans H., La.:	
Str. Gresham	85, 225, 1427 86, 223, 1290
Str. Ailsa	
Str. General Grant	
Sh. Isle Marthe	91, 231, 1869
Str. E. J. Gay	
Newtown Creek, N. Y.:	
Wreckage	98, 124, 1025
T. b. Col. Grubb	99, 147, 1277
C. b. ——	04, 126, 1053
L. —— (car float)	06, 140, 968
L. Hero	07, 147, 1022, 1023 08, 154, 1070
Brg. Kaaterskill No. 1	10, 179, 1213
Sc. ——	12, 253, 1528
New York H., N. Y.:	
Bk. Samarang	81, 115, 729
Str. Nankin	82, 116, 714 83, 111, 590 84, 121, 762 85, 114, 787
C. b. ——	92, 97, 838
Sch. F. E. Hallock	91, 93, 937
Str. Atlas	88, 67, 637 89, 82, 799
Bk. Quickstep	
C. b. Atlas	
C. b. ——	

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[1] Removed by owners.
[2] Removed by U. S. snag boat *Tombigbee*.
[3] No obstr. to navigation.
[4] Not found.
[5] Removed by strong tide or currents.
[6] Not dangerous obstrs. to navigation.
[7] Supposed to be.
[8] Removed by private parties.

Locality and vessel.	Reports of Chief of Engineers.
New York H., N. Y.—Continued.	
Str. Scotland	69, 56, 405 70, 74
Sch. Wild Pigeon	93, 105, 1076
Brg. Milton	94, 95, 786 95, 120, 998
T. Talisman	94, 95, 785
Brg. Andrew Jackson	96, 109, 869
T. William Horre	97, 138, 1158
Wreckage	98, 124, 1025
C. b. ——	98, 144, 1072
Str. Ailsa	97, 114, 1039 98, 128, 1041
Br. Samuel E. Spring	99, 147, 1277
C. b. Donnell	99, 147, 1277
Sc. dump [1]	99, 147, 1278
Str. Alvena	97, 114, 1040 98, 128, 1042 99, 147, 1276 00, 166, 1471
Brg. David Crockett	00, 166, 1472
T. B. Farrell	00, 167, 1475
Sch. Penokee	00, 167, 1474
C. b. Daisy	00, 166, 1473
Wreckage	
Brg. Jemima Leonard	01, 223, 1247
C. b. A. S. Hatch	
C. b. B. P. Ransom	01, 223, 1248
L. ——	
Brg. ——	
C. b. ——	01, 229, 1299
Sch. Grover Cleveland	
L. ——	02, 151, 982
Sch. Jacob Rivell	
Brg. Lichtenfels Bros	02, 151, 982
Brg. Ringleader	03, 145, 924
Brg. P. J. Carleton	
C. b. ——	03, 145, 924
Sch. John Comstock	
Minor obstrs.[2]	03, 145, 925
C. b. Flannery [2]	04, 134, 1126
C. b. ——	04, 134, 1127
C. b. —— [2]	
Sc. —— [3]	
Float [2]	
Sch. Eva R	05, 140, 1024
Sch. Hattie V. Kelsey	
Raft	05, 140, 1024, 1025
C. b. ——	06, 146, 991
Dumped stones	
Brg. Addie B. Bacon	08, 161, 1086
Str. Daghestan	09, 164, 1099 10, 187, 1223
Brg. Wm. H. Connor	09, 164, 1100 10, 187, 1223
Str. Finance	09, 164, 1099 10, 187, 1223 11, 209, 1313
Sch. Davlight	10, 187, 1223
Sch. J. Henry Edmunds	
C. b. M. P. DeLong	10, 187, 1224
C. b. Mary O'Donnell	
C. b. Daniel B. Fish (or Fisk)	11, 209, 1313
Brg. Hopatcong	11, 209, 1314
C. b. Martha A. Bigelow	12, 253, 1527
C. b. ——	12, 1528
C. b. Curtis & Blaisdell	
Niagara R., N. Y.:	
Brg. Massasoit [4]	06, 703
Str. Embury	07, 725, 2112 08, 769, 2186
Sc. Trader	09, 806, 2161
Nomini Creek, Va.:	
Sch. ——	12, 390, 1696
Norfolk H., Va.:	
Brg. Marion	88, 104, 774
Sch. Maggie	96, 159, 1084
Str. Helen Smith	97, 198, 1380 98, 201, 1234
Sch. John Howard	06, 250, 1140
Sch. Georgia F. Golden	07, 262, 1219
Sch. Dauntless	08, 279, 1275
Brg. John J. McNally	10, 328, 1398
Northeast R., N. C.:	
Str. St. Peter	02, 237
North R. Bar, N. C.:	
Raft [5]	03, 228, 1088
Norton Shoal, Mass.:	
Sch. Enterprise	96, 70, 667 97, 80, 927
Oakland H., Cal.:	
Bk. Agate	12, 1165, 2773
Occoquan Creek, Va.:	
Sc. No. 1	08, 263, 1251
Sc. —— [6]	08, 263, 1252
Ocean City, N. J., near:	
Brg. ——	09, 224, 1184
Ocmulgee R., Ga.:	
Str. Allen	98, 232, 1321
Ogdensburg H., N. Y.:	
Str. Massena	06, 711 07, 733, 2129
Ogeechee R., Ga.:	
T. Columbus	91, 1605
Str. Nashville	
Ohio R. (see Removal of snags):	
2 brgs. coal	95, 322, 2384
Wrecks	96, 278, 2120
11 coal brgs	94, 289, 1889
Str. Percy Kelsy [7]	01, 473, 2646
Str. Comer B.[7]	
Str. City of New Orleans [7]	
Str. Potomac [7]	
Str. Storm [7]	
Str. Homer B.[7]	
Str. W. F. Nisbet [7]	
Str. Dick Brown [7]	
Str. John Fowler [7]	
Str. Charley McDonald [7]	
76 wrecks (not named) [7]	
Coal brg.[8]	01, 505, 2816
Str. Junius S. Morgan [9]	05, 423, 1584
43 coal brgs.[10]	05, 465, 466, 1819, 1820, 1821, 1822
39 coal boats [10]	
3 flatboats [10]	
2 fuel boats [10]	
2 wharf boats [10]	
1 sand boat [10]	
3 steamboats [10]	
1 covered brg.[10]	
Str. ——	06, 1568
Str. Hudson	
Brg. Several	
Str. Fred Wilson	06, 1568, 1569
43 coal brgs.[11]	06, 1569
13 coal boats [11]	
4 coal floats [11]	
3 wharf boats [11]	
3 cinder brgs.[11]	
1 sand boat [11]	
1 flatboat [11]	
5 wrecks (not named) [11]	
Strs. (remains of 5) [11]	
3 coal boats [12]	06, 1607
3 fuel boats [12]	
Anchor [12]	

[1] Removed by owners.

[2] Removed by U. S. S. *Manisees*.

[3] Removed by U. S. S. *Manisees* and owners.

[4] Not found.

[5] Removed by U. S. snag boat *Roanoke*.

[6] Removed by U. S. S. *General Warren*.

[7] Removed by U. S. snag boat *E. A. Woodruff* and hired vessels.

[8] Removed by drs. *Louisville* and *No. 1* and *Wabash*.

[9] Removed by U. S. snag boat *J. N. Macomb*.

[10] Removed by U. S. snag boat *E. A. Woodruff* and U. S. launch *Wenonah*.

[11] Removed by U. S. snag boat *E. A. Woodruff*.

[12] Removed by U. S. snag boats.

Locality and vessel.	Reports of Chief of Engineers.
Ohio R., etc.—Continued.	
30 coal brgs.[1]	07, 540, 1677
12 coal boats [1]	
4 brgs.[1]	
1 flatboat [1]	
3 steamboats (remains of) [1]	
4 fuel flats [2]	07, 553, 1726
2 coal brgs.[2]	
2 coal boats [2]	
1 boiler [2]	
Str. U. S. S. Slackwater [2]	
17 coal brgs.[1]	08, 577, 1757
13 coal boats [1]	
3 fuel boats [1]	
2 gravel brgs.[1]	
2 scows [1]	
Wharf boat [1]	
Boiler [1]	
Str. (remains of) [1]	
Coal flat [3]	08, 589, 1795
2 coal brgs.[3]	
Flat [3]	
Oldmans Creek, N. J.:	
Brg. Sally	09, 224, 1183
Brg. Bennie	
Old Warwick Cove, Oakland Beach, R. I.:	
Sl. Tina B	12, 135, 1431
Ontonagon H., Mich.:	
T. Quail	10, 756, 2094
Pagan R., Va.:	
Sch. George W. Childs	06, 250, 1141
Sl. Lucy	10, 328, 1398
Pamlico R., N. C.:	
Brg. Albemarle	86, 159, 970
Str. Concord	87, 123, 990
Sch. ——	92, 169, 1194
Sch. ——	91, 169, 1417
Str. Concord	93, 183, 1450
Sc. ——	99, 244, 1516
Pamlico Sound (inland waterway):	
Sc. ——	10, 359
Pamunkey R., Va.:	
Brg. Amicus	89, 134, 1025 90, 121, 1084
Pile driver [4]	08, 263, 1253 09, 272, 1249
Parkers R., Mass.:	
Wreckage [5]	94, 63, 620
Sch. White Foam	95, 69, 704
Pascagoula H., Miss.:	
Sch. Robert H. Rathburn [8]	99, 317, 1783
Pasquotank R., N. C.:	
Sch. Dorcas and Eliza	88, 104, 775
Raft [6]	03, 228, 1088
Brg. John J. Ward	04, 227, 1380
Passaic R., N. J.:	
Brg. Eldorado [7]	03, 158, 954
Brg. Leon Fisher [7]	03, 159, 955
Sc. N. D. Shultz	09, 187, 1130
Sch. ——	12, 278, 1558
Pass Marianne, Miss.:	
Bk. ——	82, 193, 1388 83, 212, 1130
Patapsco R., Md.:	
Brg. ——	87, 101, 879
Sl. Mary Jane	
Sch. Cecil	00, 234, 1693
Sch. Sarah E. Vetra [9]	01, 272, 1391
Sch. Maggie [9]	01, 272, 1390
Brg. Gertrude	10, 281, 1334
Brg. Elizabeth E. Vane	12, 362, 1653
Pawtucket R., R. I.:	
Sch. L. H. Hopkins [10]	94, 63, 620 95, 702
Penobscot B., Me.:	
Sch. ——	11, 61, 1163 12, 64, 1372

Locality and vessel.	Reports of Chief of Engineers.
Penobscot R., Me.:	
Sch. Olive Branch	05, 42, 800
Sch. Annie L. Henderson	09, 47, 979 10, 58, 1098
Pensacola H., Fla.:	
Sh. Bride of Lorne	88, 158, 1189 89, 184, 1402
Bk. Laigia	
Wreckage	
T. Florence Witherbee	08, 392, 1420
Petaluma Creek, Cal.:	
Sch. Rainbow	99, 561, 3188
Philadelphia, Pa.:	
Yacht David B. Sellers [7]	98, 156, 1104
Philadelphia H., Pa.:	
Str. Shearwater	10, 223, 1274
L. Benedict [11]	12, 289, 1578
Brg. Belle Russell	12, 289, 1578
Piankatank R., Va.:	
Sunken raft	02, 218, 1108
Pigeon Cove H., Mass.:	
Sch. J. M. Eaton	99, 81, 1094
Sch. Albert H. Harding	05, 74, 836
Pleasant R., Me.:	
Sch. Golden Eagle	91, 32, 610
Sch. Cerulius	
Plum Gut, Long Isld. Sound, N. Y.:	
Sch. Edith E. Denis	12, 177, 1464
Plymouth H., Mass.:	
Brg. City of Montreal	10, 89, 1122
Brg. Harberson Hickman	11, 91, 1192, 1193
Sch. Howard A. Hunt	12, 102, 1403
Point Breeze:	
Str. Maryland	94, 118, 862
Point Celeste, La. (Miss. R.):	
Dry dock	92, 224, 1521
Point Judith, R. I.:	
Wreckage	95, 71, 723
Wreckage (spars) [13]	99, 1145
Sch. J. G. Fell	02, 122, 912
Sc. —— or float [13]	04, 86, 930
Brg. Moonbeam [13]	05, 93, 869 06, 92, 918
Pollock Rip, Mass.:	
Brg. Shamokin	95, 69, 705
Sch. Mary J. Castner	95, 70, 709
Sch. Royal Arch	95, 70, 719
Brg. Oneonta	95, 71, 726 96, 69, 665
Str. Williamsport	03, 108, 819
Pollock Rip Chan., Mass.:	
Brg. Sooloo	93, 69, 852
Brg. Storm King	93, 69, 853
Steam yacht Alva	93, 70, 857 94, 62, 604
Str. Addie G. Bryant	96, 70, 665
Str. Aransas	05, 93, 869
Brg. Shenandoah	10, 112, 1147
Pollock Rip Lightship, Mass.:	
Brg. Tivoli	96, 70, 666
Sch. —— [12]	
Sch. David Siner	01, 174, 1147
Sch. Jesse Barlow	08, 96, 995
Sch. Belle Halladay	11, 117, 1218
Pollock Rip Shoal, Mass.:	
Sch. S. L. Simmons	90, 50, 583
Sch. Weybosset	91, 61, 731 92, 65, 637
Sch. Python	92, 66, 640
Sch. Florence Nowell	92, 66, 641
Sch. Geo. V. Jordan	07, 94, 953
Sch. Rebecca Shepard	08, 96, 995
Brg. West Virginia	10, 112, 1147
Pollock Rip Slue, Mass.:	
Sch. Frank A. Magee	96, 70, 666
Sch. Levi Hart	04, 86, 930
Wreck	05, 93, 868

[1] Removed by U. S. snag boat *E. A. Woodruff*.
[2] Removed by U. S. snag boats.
[3] Removed by U. S. launches *Wenonah* and *Lazon*.
[4] Floated out of way.
[5] Not yet removed.
[6] Removed by U. S. snag boat *Roanoke*.
[7] Removed by owners.
[8] Raised and beached.
[9] Removed by U. S. steam tender *Sentinel*.
[10] Removed by the State.
[11] Removed by U. S. plant.
[12] Couldnot be located.
[13] Removed by strong tide or currents.

Locality and vessel.	Reports of Chief of Engineers.
Pollock Rip Slue, Mass.—Contd.	
Sch. Nimrod	06, 92, 919
Str. Horatio Hall	09, 90, 1024
Ponce H., Porto Rico:	
T. Mayaguez	07, 807, 2240 08, 857
Pontchartrain Lake, La.:	
Dr. boat W. H. Moore	94, 232, 1383
Brg. ——	97, 291, 1776 98, 281, 1489
Pores Isld., Va., near:	
Brg. Hudson [1]	94, 907
Str. Uriarte	03, 194, 1025 04, 193, 1274
Portage Lake Ship Canals, Mich.:	
Str. Toledo	99, 456, 2722
Str. Toledo	03, 475, 1827
Port Chester H., N. Y.:	
Sch. Richard Hall	01, 223, 1246
Port Clinton H., Ohio:	
T. Wilcox and sl. Rescue	92, 352, 2510 93, 404, 3093
Sch. Onward	00, 603, 4096
Port Henry, N. Y.:	
C. b. (4) unknown	10, 88, 1121 11, 183, 1281
C. b. Little Frank	
C. b. Jersey Lily	
Port Huron, Mich., near:	
Anchor [2] (of 1819)	04, 3139
Portland H., Me.:	
Sch. Annie J. Russel	91, 32, 609
Sch. Sarah C. Smith	06, 40
Portland Head Light, Me., near:	
Sch. Steven Bennett	04, 34, 792
Port Royal R.:	
P. b. Sprite [3]	00, 290, 1875
Port Royal H., S. C.:	
Caisson	09, 333, 1317 10, 377, 1457
Port Royal Sound, S. C.:	
Sch. Firth [4]	10, 377, 378, 1457
Portsmouth H., Me.:	
Sch. Samuel J. Goucher	12, 64, 1373
Potomac R., D. C.:	
Str. W. W. Colt	94, 145, 971
Str. Lady of the Lake	96, 152, 1064
T. Valley Forge	04, 217, 1341
Sc. ——	
Sc. ——	05, 224, 1182
Sc. ——	06, 236, 1123
T. A. P. Gorman	
Brg. Great Wardrobe	06, 236, 1123, 1124
8 wrecks	08, 1208
19 logs	
Str. W. W. Corcoran	08, 263, 1250
Sch. Plumie B. Smith	12, 389, 1694
Potomac R., Md.:	
Vessel (unknown)	03, 218, 1071
Sch. American Patriot	04, 217, 1341
Raft (piles)	05, 224, 1181
Wreck [5]	10, 307, 1373
Potomac R., Va.:	
Sch. Leading Breeze	99, 222, 1443
Sl. Thomas H. Ruark	00, 254, 1739
Brg. ——	08, 263, 1252
Sch. E. G. Irwin	09, 272, 1250
Sch. Emily Washington [6]	10, 307, 1372
Sch. —— [7]	12, 389, 1694
Powder Hole H., Mass.:	
Sch. Ellen Morrison	95, 70, 716
Presque Isle H., Mich.:	
Wreckage	94, 361, 2257 95, 395, 2840
Providence H., R. I.:	
Br. D. A. Small	04, 86, 930
Brg. Expounder	06, 96, 994
Providence R., R. I.:	
Brg. N. & W., No. 4, coal [8]	94, 62, 612
Provincetown H., Mass.:	
Sch. A. A. Holton	90, 37, 516
Sch. Wildfire	94, 49, 568
Sch. Lydia Jane	99, 81, 1095 00, 93, 1219
Sch. Hellen F. Ward	08, 77, 970
Sch. Louise C. Cabral	10, 89, 1121
Pugsleys Creek, N. Y.:	
C. b. ——	07, 147, 1023
C. b. ——	08, 154, 1070, 1071
Pultneyville, N. Y.:	
Sch. St. Peter	00, 619, 4180
Pungoteague Creek, Va.:	
Sch. Joel F. Sheppard	12, 420, 1731
Put in Bay, Ohio:	
Sch. M. P. Barkalow	02, 506, 2293
Puyallup R., Wash.:	
Str. Messenger	96, 417, 3391
Quimby Creek, S. C.:	
Wreckage	93, 189, 1530
Quonochontang, R. I.:	
Wreckage [9]	98, 94, 931 99, 1144
Racine, Wis.:	
Sch. Kate Kelly	95, 367, 2681 96, 323, 2560
Raisin R., Mich.:	
Dr. —— [10]	98, 452, 2687
Rams Horn Creek, S. C.:	
Wreckage, torpedo boat [11]	95, 207 96, 186, 1302
Rancocas R., N. J.:	
Sc. Paddy Ryan	92, 119, 940
C. b. Daisy	01, 262, 1351
C. b. Ida May	02, 190, 1063 03, 194, 1023
C. b. Ella	06, 194, 1069, 1070
T. America	11, 278, 1402
Rappahannock R., Va.:	
Sch. Spray	88, 116, 845
Sch. Lizzie Bell	12, 389, 1695
Raritan B., N. J.:	
C. b. ——	92, 97, 839
Sch. Salamander	91, 93, 937
Brg. Mist	96, 102, 801 97, 138, 1157
Brg. Satanella	00, 187, 1517
Sl. Imogene H. Terry	01, 223, 1247 06, 146, 991
Hulk ——	07, 174, 1076 08, 183, 1117, 1118
Wreck ——	10, 211, 1253, 1254
Sc. Osceola	10, 211, 1254
Raritan R., N. J.:	
Sch. Anna Augusta	97, 138, 1157
C. b. Hazelton	99, 163, 1315
Wreck ——	02, 177, 1038
C. b. Laura E. Plantz	03, 159, 955, 956
C. b. Clarence M. Curtis	06, 167, 1018
C. b. B. G. Clark	
C. b. Thomas Walker	08, 183, 1118
C. b. W. F. O'Rourke, jr.	11, 233, 1347
Richmond H., Va.:	
Brg. John Hagan [12]	99, 254, 1738
Roads H., Md.:	
Brg. Charles Gring	05, 202, 1147
Roanoke R., N. C.:	
Str. City of Long Branch	93, 183, 1450
Rockaway Inlet, N. Y.:	
Str. Governor	07, 146, 1020

[1] Removed by gunboat *Vesuvius*.
[2] Removed by U. S. S. *Hancock*.
[3] Sold at auction.
[4] Removed by U. S. dr. *Winyah Bay*.
[5] Not found.
[6] Removed by U. S. launch *General Warren*.
[7] Removal not au.
[8] Removed by owners.
[9] Could not be located.
[10] Not yet removed.
[11] Supposed to be.
[12] Removed by the city.

Locality and vessel.	Reports of Chief of Engineers.
Rockaway, N. Y., near:	
Wreck ———	10, 180, 1214
Rock Creek, Md.:	
Sch. Alethea	09, 247
Rockland H., Me.:	
Sch. Isabel Alberto	92, 39, 533 93, 37, 722
Sch. Eleazer Boynton	12, 64, 1372
Rockport H., Me.:	
Sch. Silas McLoon [1]	05, 800
Sch. Onward	06, 40
Rogers Shoal, Mass.:	
Sch. Albert F. Stearns	04, 86, 929
Rondout H., N. Y.:	
C. b. ———	96, 109, 869
Root R., Wis.:	
Sch. Mount Vernon	94, 330, 2124
Rouge R., Mich.:	
T. T. L. Higgie	09, 780, 2119
Sabine Pass, Tex.:	
Bk. Alice	00, 383, 2282
Sag H., N. Y.:	
Sch. Miller	96, 102, 802
Saginaw R., Mich.:	
Sch. Ellen	05, 590 06, 663
Str. Garden City	06, 663
Wreck ———	10, 859, 2281
St. Clair Flats, Mich.:	
Str. T. D. Stimson	04, 591, 3138, 3139
St. Clair Flats Canal, Mich.:	
Anchor [2]	03, 2047
Str. John N. Glidden	04, 591, 3139
St. Clair R., Mich.:	
Sch. M. E. Tremble	91, 361, 2801
Sch. Hannah Moore	92, 344, 2183
Sch. Mary	96, 357, 2896
Sch. Fontana	01, 570, 3198 02, 494, 2244
Sch. Martin	01, 570, 3198 02, 494, 2244 03, 2047
Sch. George H. Wand	02, 494, 2245 03, 542, 2046, 2047
Sch. Gleniffer	03, 542, 2046, 2047
Sch. Champion	04, 591, 3139
Str. Minnesota [3]	04, 591, 3139 05, 601, 2288
Str. Germanic	05, 2288
Str. City of Rome [4]	
Str. Linden	05, 2288 06, 676, 1891 07, 698, 2057 08, 742, 2138, 2139
Sch. Home	06, 676, 1891
Str. Geo. T. Burroughs	
Sch. J. Duvall	06, 676, 1891, 1892
Str. Nelson Mills	07, 698, 2057
Str. Fred Pabst	08, 743, 2139
St. Georges R., Md.:	
Sch. Samuel W. Thomas	94, 145, 970
St. Jeromes Creek, Md.:	
Sch. Geo. W. Krebs [5]	10, 307, 1373
St. Johns R., Fla.:	
Str. Maple Leaf	83, 186, 955 88, 151, 1122 89, 174, 1352
Br. Neva	88, 151, 1122
Brg. ———	89, 174, 1352
Sch. Ridgewood	05, 309, 1320
Str. Commodore Barney	06, 331, 1240
Wreck	07, 347
Str. Ruby [6]	08, 368

Locality and vessel.	Reports of Chief of Engineers.
St. Johns R., Fla.—Continued.	
Str. Magic City	11, 462
Str. Chatham	11, 463
Str. Zeeburg	12, 567
St. Jones R., Del.:	
Str. Mary U. Githens	04, 178, 1249 05, 186, 1122
Sch. Mary	05. 186, 1124 06, 194, 1069
St. Josephs H., Mich.:	
Str. City of Duluth	99, 505, 2951 00, 568, 3933
T. Payne	12, 1057, 2613
St. Josephs R., Mich.:	
Str. Reid	97, 434, 2947
St. Lawrence R., N. Y.:	
Str. Islander	10, 899, 2338
St. Marys R., Mich.:	
Sch. Bruce	97, 451, 3033
T. Martin Swain	02, 494, 2244
Timber crib	04, 3139
Dump sc.	06, 676, 1891
Str. John B. Ketcham 2d	11, 914, 2476 12, 1091, 2676
Sch. A. C. Maxwell	11, 914, 2476
Sakonnet H., R. I.:	
Str. Queen City	08, 96, 994
Salem R., N. J.:	
Sc. John E. King	12, 328, 1619
Salisbury H., Md.:	
Sch. Compact	10, 281, 1384
Sandusky H., Ohio:	
Sch. Benson	01, 584, 3269
Str. Philip Minch	05, 619, 2368 06, 693, 1921
San Francisco B., Cal.:	
Sh. May Flint [7]	01. 613, 3434
San Francisco H.:	
Str. Escambia	82, 317, 2636 83, 330, 1992 84, 333, 2201 85, 359, 2339 86, 352, 1915 87, 319, 2426
San Joaquin R., Cal.:	
Brg. ———	85. 360, 2339
San Juan H., P. R.:	
Str. Cristobal Colon	01. 657, 3635
Sankaty Head, Mass.:	
Sch. Dora Mathews	04, 86, 929
Sch. Agnes E. Manson	
San Pedro H., Cal.:	
Sailboat	02, 525, 2346
Sassafras R., Md.:	
Brg. Rose Hagen [8]	97, 171, 1289
Saugerties H., N. Y.:	
Sl. Courier	04, 125, 1052
Savannah H., Ga.:	
Str. Habersham	91, 184, 1602
Str. Milledgeville	
Str. General Lee	
Bk. Undine	93, 108, 1606 94, 182, 1209
Str. David Clarke	94, 182, 1209
T. Leon	
P. b. ———	
3 wrecks	
4 wrecks	95. 207, 1519
Wreckage	96. 186. 1303
5 wrecks	96, 186, 1302
Bl. lighter Cypress	99, 266, 1592 00, 306, 1961
Sc. dump ———	99. 266, 1592
Str. W. S. Cook	01, 334, 1660
Sch. Livingston [9]	03, 271, 1171 04, 279. 1668
Sch. Arthur C. Wade [9]	07, 327, 1302 08, 346, 1359

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[1] Removed by owners.
[2] Removed by U. S. str. *Hancock*.
[3] Removed by Canadian Government.
[4] Owners made contract for raising.
[5] No obstr. to navigation.
[6] Removed by U. S. dr. *Florida*.
[7] Removed by owner.
[8] Removed by wrecking company.
[9] Removed by U. S. snag boat *Tugaloo*.

Locality and vessel.	Reports of Chief of Engineers.
Savannah R., Ga.:	
L. ———	00, 306, 1961 01, 334, 1660
Str. Pete Craig	01, 334, 1660 02, 264, 1200
Schuylkill R., Pa.:	
Bk. Felix	93, 1183
C. b. William Cummings	00, 206, 1588
C. b. James Gillan	00, 206, 1589
Yacht David B. Sellers [1]	98, 156, 1104
T. Fleetwing [1]	01, 263, 1350
C. b. Edward L. Meyers	01, 262, 1352
C. b. Meadowbrook	01, 263, 1352
C. b. Peter A. Rogers	02, 190, 1063
L. No. 33	
Sl. Three Brothers [2]	03, 194, 1024
C. b. ———	04, 156, 1201
C. b. ———	05, 163, 1085
C. b. ———	06, 176, 1040
Sc. Macyck [3]	12, 289, 1576
Brg. ——— [3]	12, 289, 1578
Scuppernong R., N. C.:	
Sch. Lawrence	85, 164, 1044 86, 159, 970
Seabright, N. J., near:	
Str. Macedonia [4]	00, 1516 01, 223, 1247
Seal H., Me.:	
Sch. Vicksburg	00, 62, 1100
Sch. Island Queen	08, 43, 939
Severn R., Md.:	
Sc. ——— [5]	04, 193, 1273
Sharps Isld. Lighthouse, Chesapeake B., Md.:	
Trunk of a large tree [6]	96, 972
Sheboygan H., Wis.:	
Sch. Petrel	84, 284, 1860
Sch. R. H. Becker	08, 669, 1984
Sheep Pen Hill, Va., near:	
Str. Oakdene	10, 255, 1310
Sheepshead B., N. Y.:	
Sch. John B. Conover	97, 139, 1158
Shelter Isld., N. Y.:	
Sch. Wm. Everett [1]	99, 1278
Ship Isld. H., Miss.:	
Bk. Bruce	91, 228, 1837 92, 223, 1513
Wreckage	94, 232, 1384
Shovelful Shoal, Mass.:	
Sch. Ellen Morrison [7]	95, 70, 716
Brg. Wadena	03, 103, 819
Sch. Viola May	05, 93, 868, 869
Shovelful Shoal and Monomoy Pt. (between), Mass.:	
Sch. Ada Ames	12, 135, 1430
Shrewsbury R., N. J.:	
Sl. Success	01, 223, 1247
Smith Creek, N. C.:	
Sch. R. D. Bateman	07, 288
Smith Creek, Va.:	
Sch. Briton M. Tilton	95, 176, 1295
Brg. ——— [8]	07, 263, 1219 08, 279, 1275
Sch. Edith Fowle	08, 279, 1275
Smyrna R., Del.:	
Sch. Mary H. Rhoads	91, 131, 1201
Sc. ———	98, 175, 1172 99, 202, 1398
C. b. Zeus	01, 263, 1352 02, 190, 1062
Southampton, N. Y.:	
T. Panther	94, 82, 713
Southbend H., Wash.:	
Sch. Challenger	05, 710, 2560
South Chan., Charleston, S. C.:	
Bk. Red Earl	91, 178, 1487
South Manitou H., Mich.:	
Sch. Margaret Dall	12, 1057, 2613
Southwest Pt., R. I.:	
Brg. Nora	04, 86, 930
Stamford H., Conn.:	
Sch. yacht Adrienne	11, 148, 1251 12, 176, 1463
Starve Isld. Reef:	
Sch. Amorette Mosher	03, 556, 2105
Stonington H., Me.:	
Sch. A. H. Whitmore	05, 800
Stoney Pt., Ohio:	
Sch. General Franz Sigel	04, 608, 3208 05, 618, 2367, 2368
Sturgeon B., Wis.:	
Sc. ———	01, 527, 2970
Superior B., Minn.:	
Str. Winnipeg	98, 385, 2287
Superior Entry, Wis.:	
T. Edward Gillen	03, 1828
Swan Creek, Ohio:	
Sand sucker Syracuse	09, 797, 2141
Sycamore Slough, Cal.:	
Dr. ———	09, 834, 2197
Tacoma H., Wash.:	
Str. Messenger	96, 417, 3391
Tallahatchie R., Miss.:	
Str. Star of the West	97, 308, 1932
Tanners Creek, Va.:	
Sch. Maggie Shearer	11, 350, 1510, 1511
Tampa, Fla.:	
Piling	06, 331, 1240
Tampa B., Fla.:	
Str. Millie Wales	95, 221, 1560 96, 198, 1337
L. ———	97, 251, 1566
Sch. Henry Stanbery	00, 326, 2032
Tampa H., Fla.:	
Str. Dictator	85, 199, 1279 86, 197, 1157 87, 162, 1256
Tanana R., Alaska:	
Str. Rook Isld	07, 802, 2232 08, 851, 2311
Tangier Sound, Md.:	
Sch. Columbia	01, 272, 1390
Sch. Angy MacNamara	04, 193, 1273
Sch. Emma J. Thomas	
Sch. Mary A. Kirwan	10, 281, 1334
Tangier Sound, Va.:	
Sch. Mary L. Colbourne	05, 202, 1147
Tarpaulin Cove H., Mass.:	
Sch. E. K. Hart	95, 70, 714
Teche Bayou, La.:	
Str. J. M. Chambers	85, 225, 1428
Str. Maria A	87, 188, 1392
Brg. ———	92, 223, 1513
2 brgs	93, 250, 1839
3 coal brgs	05, 365, 1456
Logs	07, 409, 1430
4 brgs	08, 431, 1483
Steam launch	
Old hull	
Tennessee R., Ala.:	
Brg. ———	07, 536, 1652
Thoroughfare, connecting East Creek with Dennis Creek, N. J.:	
Sch. James D. Godfrey	11, 277, 1401
Thunder B., Mich.:	
Str. New Orleans [9]	07, 698, 2058
Sch. or brg. ———	
Str. Oscar T. Flint [10]	10, 860, 2281 11, 914, 2475
Toledo H., Ohio:	
Sch. Ferrell	96, 368, 2972
Toledo Light, Ohio, near:	
Str. Lucille	07, 716, 2096
Tortugas, Fla.:	
Sch. Nannie Bohlin	10, 424

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[1] Removed by owners.
[2] No obstr.
[3] Removed by U. S. plant.
[4] Removed by U. S. and private parties.
[5] Removed by U. S. str. *Sentinel*.
[6] Removed by ice and waves.
[7] Drifted to Powder Hole H., Mass.
[8] Removed by U. S. snag boat *Roanoke*.
[9] Removed by U. S. t. *Johnson*.
[10] Removed by U. S. str. *Hancock*.

Locality and vessel.	Reports of Chief of Engineers.
Townsend Inlet, N. Y.:	
Str. Nuphar	92, 119, 940
Tucker Beach Light, N. J., near:	
Sch. R. & T. Hargraves	03, 194, 1026
Turners Cut, N. C.:	
Brg. Kingston	02, 226, 1126
Urbana Creek, Va.:	
Sch. Kate Lawson	98, 192, 1221 99, 222, 1442
Vermillion Bayou, La.:	
Str. Exchange	96, 225, 1520
Vineyard Haven H., Mass.:	
Sch. Mary E. Oliver	92, 65, 639
Sch. Alma	89, 55, 640 94, 62, 609
R. H. Shannen [1]	94, 62, 609
Julia or Juliette [1]	
4 wrecks	
Sch. Mary B. Smith	98, 84, 931
Sch. Hector	00, 110, 1281
Sch. E. C. Willard	
Sch. J. D. Ingraham [2]	
Sch. Nellie Doe [2]	
Sch. Viola	06, 92, 919
Vineyard Sound, Mass.:	
Sch. T. P. Dixon [1]	95, 71, 722
Sch. Josiah R. Smith	95, 71, 725
Sch. Harry L. Whiton	95, 70, 718
Sch. Dora M. French	95, 69, 708
Wreckage [3]	95, 701
Wreckage [2]	97, 80, 928
Sch. R. L. Dewis	98, 83, 931
Sch. Angola	98, 84, 932 99, 96, 1144
Sch. Lunet	00, 110, 1281
Sch. George S. Tarbell	93, 69, 852
Sch. Marriott	04, 86, 929
Sch. Joseph Hay	06, 92, 919
Sch. Mail	
Str. Trogan	07, 94, 953
Brg. Pemberton	07, 94, 954
Sch. Sagmore	
Sch. James S. Steel	08, 96, 994
Vineyard Sound, Mass.—Contd.	
Sch. Demoiselle (Br.)	08, 96, 995
Sch. Charles J. Willard	10, 112, 1147
Wachapreague Inlet, Va., near:	
Str. Amy Dora	03, 194, 1025 04, 193, 1274
Waiska B.:	
L. Monitor	99, 522, 3015
Warrior R., Ala.:	
Str. Baltimore	03, 324, 1272
Washington, D. C.:	
Str. Lady of the Lake	96, 152, 1064
Washington Park, N. J.:	
C. b. Elk [2]	96, 939
Watch Hill, R. I.:	
Brg. Excelsior	08, 96, 994
Brg. No. 701	
Weymouth, Fore R., Mass.:	
Wreckage	99, 81, 1096
Wicomico R., Va.:	
Sch. Itinerant	12, 390, 1695
Willapa H., Wash.:	
Sch. Challenger	06, 786, 2047
Willoughby B., Va.:	
Sl. A. M. C. Smith	11, 350, 1510
Wilmington H., Cal.:	
Bk. Adelaide Cooper	07, 2136
Wilmington H., Del.:	
5 wrecks	97, 170, 1288
Wing Pt., Wis.:	
Sch. Lumberman	93, 358, 2777
Woodbury Creek, N. J.:	
Brg. Lydia & Mary	10, 255, 1309
Woods Hole H., Mass.:	
Wreckage	95, 69, 706
Wysocking B., N. C.:	
Sch. Hooper [4]	01, 309, 1511
Yazoo R., Miss.:	
Str. Ford R. [5]	01, 420, 2048
Shaft of str. Rover [5]	
Str. J. A. Townes	09, 531
York R., Va.:	
Sch. Anna M Harris	03, 218, 1071

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[1] Supposed to be.
[2] Removed by owners.
[3] Removed by gunboat *Vesuvius*.
[4] No serious menace to navigation.
[5] Removed by U. S snag boat *Columbia*.

SPECIAL SUBJECTS.

REPORTS, CHIEF OF ENGINEERS, U. S. ARMY, 1866-1912.

SECTION 5.—SUMMARY OF APPROPRIATIONS—RIVER AND HARBOR WORKS.[1]

NOTES.—The matter in this section is composed of the following: Pages of this index.

Part A:

Table 1.—Appropriations by act, 1802 to 1915 2279
Table 2.—Appropriations, South Pass, Mississippi River, Eads project 2283
Table 3.—Expenditures, wreck removal 2284
Table 4.—Expenditures, operating and care of canals 2284
Table 5.—Expenditures, examinations and surveys, at South Pass, Mississippi River 2284
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Table 8.—Expenditures, removal of snags and wrecks, Mississippi River 2285
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Recapitulation and grand total 2286

Part B:

Table 11.—Totals, by works of improvement, as detailed in this index, pages 28 to 1690 2287
Table 12.—Totals, by districts, as detailed in this index, pages 28 to 1690 2302

PART A.

TABLE 1.—*River and harbor appropriations, by acts, Apr. 6, 1802, to Mar. 4, 1915.*

Quoted from H. D. 1491, 63d, 3d, p. 387.

Date of act.	Rivers.	Harbors.	Canals.	Examinations, surveys, and contingencies.	Total.
Apr. 6, 1802	$30,000.00				$30,000.00
Apr. 18, 1806	448.71				448.71
Feb. 10, 1809			$25,000.00		25,000.00
Feb. 15, 1819				$6,500.00	6,500.00
Apr. 14, 1820				9,500.00	9,500.00
Mar. 3, 1821	150.00				150.00
Do				2,500.00	2,500.00
May 7, 1822		$34,200.00			34,200.00
Mar. 3, 1823		6,000.00		150.00	6,150.00
Apr. 30, 1824				30,000.00	30,000.00
May 24, 1824	75,000.00				75,000.00
May 26, 1824		40,000.00			40,000.00
Feb. 21, 1825				28,567.00	28,567.00
Mar. 6, 1825		52,972.56			52,972.56
Mar. 3, 1825			300,000.00		300,000.00
Do		11,712.00		400.00	12,112.00
Mar. 3, 1826				20,000.00	20,000.00
Mar. 25, 1826		20,184.90		50,000.00	70,184.90
May 13, 1826			100,000.00		100,000.00
May 18, 1826			150,000.00		150,000.00
Do		50,000.00			50,000.00
May 20, 1826	25,000.00	57,320.00		3,000.00	85,320.00

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[1] For a summary of appropriations for fortifications, see p. 1801 of this index. No summary of appropriations for miscellaneous works would serve any practical purpose, and hence there is no summary for Part III of this index.

Date of act.	Rivers.	Harbors.	Canals.	Examinations, surveys, and contingencies.	Total.
Mar. 2, 1827		$2,000.00		$30,000.00	$32,000.00
Do	$12,000.00	69,476.45		700.00	82,176.45
Do	5,383.40				5,383.40
Mar. 3, 1827	30,000.00				30,000.00
Mar. 19, 1828		2,000.00			2,000.00
May 19, 1828	3,500.00	73,482.29		30,000.00	106,982.29
May 23, 1828	150,513.00	158,500.00		2,300.00	311,313.00
Do		250,000.00			250,000.00
May 24, 1828			$1,000,000.00		1,000,000.00
Mar. 2, 1829	30,000.00	146,097.00		2,710.00	178,807.00
Do			200,000.00		200,000.00
Do				30,000.00	30,000.00
Do			133,500.00		133,500.00
Do		7,310.54			7,310.54
Mar. 3, 1829	50,000.00	55,003.25			105,003.25
Apr. 23, 1830	95,694.72	271,428.76			367,123.48
May 31, 1830				40,400.00	40,400.00
Mar. 2, 1831		5,000.00			5,000.00
Do	46,880.00	389,484.34		187.50	436,551.84
Do	200,000.00			25,000.00	225,000.00
Feb. 24, 1832		9,000.00			9,000.00
July 3, 1832	154,970.32	528,590.43		30,000.00	713,560.75
July 4, 1832				3,000.00	3,000.00
Mar. 2, 1833	15,000.00	25,000.00		500.00	40,500.00
Do	95,900.00	384,900.00		25,000.00	505,800.00
Do		8,430.62			8,430.62
Do	48,266.60				48,266.60
June 27, 1834		262.16		2.84	265.00
June 28, 1834	155,527.00	547,756.00		24,000.00	727,283.00
June 30, 1834			28,337.55		28,337.55
Do				500.00	500.00
Do	70,000.00				70,000.00
Do	6,240.63				6,240.63
Feb. 24, 1835		30,000.00			30,000.00
Do	17,000.00				17,000.00
Mar. 3, 1835	231,000.00	227,057.03			458,057.03
Do				25,000.00	25,000.00
July 2, 1836	395,600.05	283,719.90		25,000.00	704,319.95
July 4, 1836	160,000.00	303,000.41	15,000.00	5,100.00	483,100.41
Mar. 3, 1837	754,963.00	600,759.00	300,000.00	11,000.00	1,666,722.00
Do				30,000.00	30,000.00
Apr. 20, 1838	70,000.00				70,000.00
July 7, 1838				2,000.00	2,000.00
Do	408,573.00	1,058,744.16	10,000.00		1,477,317.16
Do				2,000.00	2,000.00
Mar. 3, 1839				2,000.00	2,000.00
Do		500.00			500.00
Do	15,000.00			500.00	15,500.00
Do				1,500.00	1,500.00
May 8, 1840				150.29	150.29
July 20, 1840	1,075.39				1,075.39
Mar. 3, 1841		17,500.00			17,500.00
Do		4,369.00			4,369.00
Do	75,000.00				75,000.00
Sept. 9, 1841		5,000.00		40,000.00	45,000.00
June 4, 1842				8,000.00	8,000.00
Aug. 23, 1842	100,000.00			45,000.00	145,000.00
Aug. 31, 1842		2,000.00			2,000.00
Mar. 1, 1843	150,000.00				[1] 150,000.00
Do	3,471.57				3,471.57
Mar. 3, 1843		16,000.00			16,000.00
Do		80,000.00			80,000.00
Do		2,680.01			2,680.01
June 11, 1844	805,000.00	350,000.00			655,000.00
June 15, 1844		12,500.00			12,500.00
Do		12,500.00			12,500.00
Do	7,500.00				7,500.00
Do	14,000.00				14,000.00
Do		320.89			320.89
Do		1,150.00			1,150.00
Do		536.74			536.74
Do		412.12			412.12
Feb. 13, 1845		18,437.27			18,437.27
Feb. 26, 1845			5,000.00		5,000.00
Mar. 3, 1845	240.00				240.00
Do		5,266.96			5,266.96
Do		15,000.00			15,000.00
Do	7,000.00				7,000.00
Aug. 10, 1846				4,988.00	4,988.00
Mar. 2, 1847	7,751.92				7,751.92

[1] $15,000 were also appropriated for surveys in reference to military defenses of the frontier, inland and Atlantic, including a survey of the direct communication from Albemarle Sound to the Atlantic Ocean, with a view to reopening a ship channel.

Date of act.	Rivers.	Harbors.	Canals.	Examinations, surveys, and contingencies.	Total.
Mar. 3, 1847	$6,479.25				$6,479.25
Do		$645.30			645.30
July 20, 1848		40,000.00			40,000.00
Mar. 3, 1849				$1,500.00	1,500.00
Do		5,000.00			5,000.00
Do	651.76				651.76
Sept. 30, 1850				50,000.00	50,000.00
Aug. 30, 1852	1,074,590.00	940,000.00		84,700.00	2,099,290.00
Aug. 31, 1852				50,000.00	50,000.00
Mar. 3, 1853		877.42			877.42
July 22, 1854	140,000.00				140,000.00
Mar. 2, 1855		922.65			922.65
Mar. 3, 1855		161,000.00			161,000.00
Do		1,696.15			1,696.15
Do		8,617.81			8,617.81
July 8, 1856	330,000.00				330,000.00
Do	100,000.00				100,000.00
Do	45,000.00				45,000.00
Aug. 16, 1856		100,000.00			100,000.00
Do	200,000.00				200,000.00
Mar. 3, 1857		20,833.00			20,833.00
June 7, 1858		2,502.11			2,502.11
Feb. 9, 1859		809.65			809.65
June 9, 1860	1,350.00				1,350.00
June 12, 1860	1,406.94				1,406.94
Apr. 9, 1864		1,778.36			1,778.36
Do		2,224.00			2,224.00
Do		99.00			99.00
May 19, 1864		308 00			308.00
June 28, 1864		350,000 00			350,000.00
July 1, 1864			$225,276.83		225,276.83
July 2, 1864		87,500 00			87,500.00
Feb. 28, 1865		23,000 00			23,000.00
June 12, 1866		125,000 00			125,000.00
June 23, 1866	1,558,900 00	1,604,147.91	280,000.00	255,000.00	3,698,047.91
July 28, 1866		8,000 00			8,000.00
Mar. 2, 1867	1,374,688 00	2,423,093.70	650,000 00	255,000.00	4,702,781.70
Do	36.000 00	2,500 00			38,500.00
July 25, 1868	712,000.00	418,530.00	471,000.00		1,601,530.00
Apr. 10, 1869	708,188.00	769,022.27	498,960 00	23,829.73	2,000,000.00
Dec. 23, 1869			200,000.00		200,000.00
May 5, 1870				500.00	500.00
July 11, 1870	1,768,500 00	1,210,900.00	816,500.00	150,000.00	3,945,900.00
July 15, 1870	5,000 00	225,000.00		50,000.00	280,000.00
Jan. 18, 1871			541,000 00		541,000.00
Feb. 2, 1871			100,000 00		100,000.00
Mar. 3, 1871	1,595,000 00	1,886,000.00	751,500 00	175,000.00	4,407,500.00
June 10, 1872	13,713.97				13,713.97
Do	2,430,300 00	2,003,700.00	1,004,000.00	150,000.00	5,588,000.00
Jan. 8, 1873		15,000 00			15,000.00
Mar. 3, 1873	2,885,000.00	2,292,900 00	800,000 00	125,000 00	6,102,900.00
Do	34,988.53				34,988.53
Do		8,132.95			8,132.95
Feb. 25, 1874		20,000 00			20,000.00
Feb. 27, 1874		193,132.96			193,132.96
Apr. 3, 1874	30,000.00				30,000.00
May 11, 1874			1,675,354.31		1,675,354.31
June 22, 1874				25.000 00	25,000.00
June 23, 1874	2,452,500.00	1,875,500.00	600,000.00	300,000.00	5,228,000.00
Do	10,000.00				10,000.00
Mar. 3, 1875	3,478,000.00	2,325,517.50	780,000.00	65,000.00	6,648,517.50
May 1, 1876				2,100.28	2,100.28
July 31, 1876	10,000.00				10,000.00
Aug. 14, 1876	2,888,500.00	1,636,500.00	450,000.00	40,000.00	5,015,000.00
Feb. 7, 1878	46,000.00				46,000.00
Apr. 30, 1878			7,500.00		7,500.00
June 7, 1878		75,000.00			75,000.00
June 18, 1878	5,469,900.00	2,086,800.00	425,000.00	220,000.00	8,201,700.00
June 20, 1878	9,513.00				9,513.00
Jan. 13, 1879	101,536.72				101,536.72
Mar. 3, 1879	4,190,600 00	2,333,000.00	368,000.00	205,000.00	7,096,600.00
June 28, 1879	175,000.00				175,000.00
Jan. 23, 1880		25,000.00			25,000.00
June 14, 1880	5,530,500.00	2,837,500.00	432,755.36	180,000.00	8,980,755.36
June 16, 1880	5,010 00				5,010.00
Do	150,000.00				150,000.00
Jan. 13, 1881				50,000.00	50,000.00
Mar. 3, 1881	150,000 00			10,000.00	160,000.00
Do	7,395,000.00	3,649,300.00	317,000.00	80,000.00	11,441,300.00
Mar. 4, 1882		100,000.00			100,000.00
Mar. 21, 1882	100,000.00				100,000.00
May 4, 1882	50,000.00				50,000.00
June 19, 1882		10,000.00			10,000.00

Date of act.	Rivers.	Harbors.	Canals.	Examinations, surveys, and contingencies.	Total.
Aug. 2, 1882	$12,676,900.00	$5,499,475.00	$325,000.00	$237,500.00	$18,738,875.00
Aug. 7, 1882	150,000.00			2,000.00	152,000.00
Mar. 3, 1883	2,460.00				2,460.00
Do	150,000.00				150,000.00
Jan. 19, 1884	1,000,000.00				1,000,000.00
Mar. 12, 1884	8,100.00				8,100.00
July 5, 1884	9,042,500.00	4,200,100.00	530,000.00	167,600.00	13,940,200.00
July 7, 1884	81,479.32				81,479.32
May 26, 1886	6,492.00				6,492.00
Aug. 4, 1886	129,404.57				129,404.57
Aug. 5, 1886	8,547,025.00	5,083,125.00	681,250.00	153,500.00	14,464,900.00
Feb. 1, 1888	176,380.32				176,380.32
Mar. 5, 1888				5,000.00	5,000.00
Mar. 30, 1888	8,800.00				8,800.00
Apr. 2, 1888	7,572.48				7,572.48
May 21, 1888		8,174.79			8,174.79
Aug. 11, 1888	12,790,935.19	7,689,000.00	1,576,250.00	180,000.00	22,236,185.13
Oct. 1, 1888				10,000.00	10,000.00
Oct. 2, 1888	35,000.00				35,000.00
Oct. 19, 1888	46,525.06				46,525.06
Mar. 2, 1889	62,060.00				62,060.00
Do				2,000.00	2,000.00
Feb. 22, 1890	150,000.00				150,000.00
Mar. 17, 1890		6,100.00			6,100.00
Apr. 4, 1890		10,000.00			10,000.00
Aug. 30, 1890	3,735.00				3,735.00
Sept. 19, 1890	14,428,050.00	7,963,561.85	2,367,000.00	278,000.00	25,036,611.85
Sept. 30, 1890	162,178.04				162,178.04
Jan. 19, 1891	2,128.87				2,128.87
Mar. 3, 1891	1,950.00				1,950.00
Do	300,000.00	1,051,200.00	600,000.00		1,951,200.00
Do	1,000,000.00				1,000,000.00
July 13, 1892	12,856,529.00	7,120,106.00	1,018,083.00	159,500.00	21,154,218.00
July 28, 1892	109,067.41	.22			109,067.63
Aug. 5, 1892	115,000.00	699,000.00			814,000.00
Mar. 1, 1893				15,000.00	15,000.00
Mar. 3, 1893	7,349,500.00	4,372,000.00	2,444,653.00		14,166,153.00
Do	95,986.65				95,986.65
June 23, 1894		6,391.12			6,391.12
Aug. 8, 1894		5,434.18			5,434.18
Aug. 18, 1894	6,701,180.00	[1] 4,207,000.00	425,000.00	165,000.00	11,498,180.00
Do	5,335,000.00	2,765,000.00	300,000.00		8,400,000.00
Aug. 23, 1894	6,325.28				6,325.28
Do	1,916.97				1,916.97
Jan. 25, 1895		200,000.00			200,000.00
Mar. 2, 1895	15,000.00				15,000.00
Do	6,770,700.00	4,187,550.00	483,865.00	10,000.00	11,452,115.00
Feb. 26, 1896	500.00	300,000.00			300,500.00
Do				1,500.00	1,500.00
May 1, 1896	17,811.96				17,811.96
May 11, 1896		1,289.33			1,289.33
June 3, 1896	11,340,625.46	[2] 4,635,540.00	335,000.00	268,000.00	16,579,165.46
June 11, 1896	980,000.00	2,125,000.00	179,597.00	15,000.00	3,299,597.00
Do			8,265.19		8,265.19
Feb. 26, 1897	250,000.00				250,000.00
Mar. 31, 1897	250,000.00				250,000.00
June 4, 1897	9,789,333.00	7,742,079.91	1,575,000.00	[3] 185,000.00	19,291,412.91
July 19, 1897	1,156,015.65	55,000.00		311.17	1,211,326.82
Apr. 11, 1898		2,000.00			2,000.00
July 1, 1898	6,399,739.56	5,852,730.00	2,029,990.00	225,000,00	14,507,459.56
July 7, 1898	1.42	360,000.00			360,001.42
Mar. 3, 1899	5,108,233.00	3,109,864.00	715,000.00		9,023,197.00
Do	31.79				31.79
Do	[4] 7,387,576.25	[5] 7,239,265.69	205,000.00		15,131,841.94
Feb. 9, 1900					20,000.00
June 6, 1900	7,998,964.00	6,131,636.75	1,110,000.00		15,240,605.74
June 6, 1900	18.00				18.00
Do	[6] 125,368.16	99,437.56		[7] 35,194.28	260,000.00
Mar. 1, 1901		10,200.00			10,200.00
Mar. 3, 1901	1,995,046.00	3,946,577.00	1,120,009.00		7,061,623.00
Do	4.59				4.59

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[1] Includes payment of $30,000 to C. P. Goodyear for work at Brunswick outer bar, Georgia.

[2] Includes payment of $100,000 to C. P. Goodyear for work at Brunswick outer bar, Georgia.

[3] Includes $10,000 to be expended by the Secretary of the Navy for survey of Pearl Harbor, Hawaii.

[4] As amended by act of Feb. 20, 1900.

[5] Includes payment of $90,000 to C. P. Goodyear for work at Brunswick outer bar, Georgia.

[6] Does not include app. of $200,000 for purchase of plant belonging to estate of James B. Eads at South Pass, Mississippi R., the amount not having been expended.

[7] Includes $10,000 to be expend. by Sec. of Navy for sur. of Guam H.

Date of act.	Rivers.	Harbors.	Canals.	Examinations, surveys, and contingencies.	Emergencies.	Total.
Feb. 14, 1902	$1.96					$1.96
June 13, 1902	[1]16,071,892.00	[2]$9,119,550.00	$805,000.00	$325,009.00	$200,000.00	26,521,442.00
June 28, 1902	1,537,275.00	3,503,262.50	743,220.00			5,783,757.50
July 1, 1902	25,000.00					25,000.00
Mar. 3, 1903	6.01					6.01
Do	11,559,540.33	8,505,610.66	178,000.00			20,243,150.99
Apr. 28, 1904	5,295,000.00	2,592,200.00				7,887,200.00
Do					835,274.34	[3]835,274.34
Mar. 3, 1905	10,096,483.41	6,854,392.00	606,000.00	325,000.00	300,000.00	18,181,875.41
Do	5,421,316.00	5,137,816.00				10,559,132.00
Apr. 23, 1906	400,000.00					400,000.00
June 28, 1906			10,000.00			10,000.00
June 30, 1906	21.42					21.42
Do	11,104,868.63	5,964,181.41	200,000.00			17,269,050.04
Mar. 2, 1907	21,968,650.92	13,823,021.08	666,411.00	350,000.00	300,000.00	37,108,083.00
Mar. 4, 1907	2,791,065.00	3,616,665.00				6,407,730.00
May 27, 1908	9,359,800.00	8,083,145.00	665,000.00			18,107,945.00
Mar. 3, 1909	4,848,250.00	3,169,000.00	168,500.00	700,000.00	500,000.00	9,385,750.00
Mar. 4, 1909	11,777,214.00	7,702,300.00	290,000.00			19,769,514.00
Jan. 19, 1910	10,000.00					10,000.00
June 25, 1910	23,893,890.70	14,459,272.80	1,124,075.00	500,000.00	300,000.00	[4]40,277,238.50
Do	5,415,918.00	2,650,510.00				8,066,428.00
Do	600.00					600.00
Feb. 27, 1911	16,491,880.00	6,425,962.00	542,500.00	300,000.00		23,760,342.00
Mar. 4, 1911	4,016,000.00	2,877,077.00	150,000.00			7,043,077.00
Apr. 3, 1912	350,000.00					350,000.00
Apr. 16, 1912	300,000.00					300,000.00
Apr. 30, 1912	1,500,000.00					1,500,000.00
May 9, 1912	50,000.00					50,000.00
July 25, 1912	21,890,890.50	6,514,980.00	1,049,500.00	300,000.00		[5]29,455,370.50
Aug. 24, 1912	5,385,000.00	3,630,250.00	500,000.00			9,515,250.00
Aug. 26, 1912	4.67	177.21				181.88
Mar. 4, 1913	30,495,390.00	9,166.749.00	1,309.225.00	250,000.00		41,221,364.00
June 23, 1913	6,597,150.00	2.363,645.00	1,100,000.00			10,060,795.00
Aug. 1, 1914	4,609,500.00	1,968,000.00	426,000.00			7,003.500.00
Oct. 2, 1914	15,640,350.09	3,134,030.00	367,400.00		[6]858,220.00	20,000,000.00
Mar. 3, 1915	3,797,000.00	200,000.00				3,997,000.00
Mar. 4, 1915	18,098,571.50	2,968,850.00	398,550.00	500,000.00	[6]3,034,028.50	25,000,000.00
Total	475,211,250.47	269,273,040.59	42,989,018,24	9,271,891.09	[7]6,027,322.84	802,772,723.23

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[1] As amended by act of June 28, 1902.

[2] Includes payment of $45,000 to C. P. Goodyear for work at Brunswick outer bar, Georgia.

[3] This is the actual amount allotted from the app. of $3,000,000 made by this act; the balance, $2,164,725.66, by the terms of sec. 8 of the act of Mar. 3, 1905, being made available to apply upon the cost of imps. enumerated in that act, thereby reducing to $16,017,149.75 the actual amount app. by the act of 1905.

[4] Does not include $50,000 app. for expenses of the Permanent International Association of Navigation Congresses, $1,875 for services of Hon. John H. Bankhead, and $1,000,000 for waterway from Lockport to mouth of Illinois R., repealed by act of Mar. 4, 1915.

[5] Does not include $1,500,000 deducted from app. for Mississippi R. in accordance with the provisions of the act of Apr. 30, 1912, and $300,000 allotted to ex., sur., and contingencies from previous app. for emergencies.

[6] Reserved for emergencies.

[7] Omits $300,000 applied to examinations, surveys, and contingencies under the provisions of the act of July 25, 1912.

South Pass Jetties.

TABLE 2.—*Statement of appropriations and expenditures provided by act of Mar. 3, 1875, and amendatory acts for improvement of South Pass, Mississippi River, by James B. Eads and his legal representatives.*

Under the act of Mar. 3, 1875, and amendatory acts, there was to be paid James B. Eads or his legal representatives, upon securing certain widths and depths of channel, the sum of	$4,250,000
80 quarterly payments of $25,000 each for maintenance	2,000,000
20 semiannual payments of 5 per cent interest on the $1,000,000 retained as pledge, amounting to	500,000
One-half of the $1,000,000 retained to be then released	500,000
20 semiannual payments of 5 per cent interest on the $500,000 still retained as a pledge, amounting to	250,000
Remaining one-half of the $1,000,000 retained to be then released	500,000
Total	8,000,000

Wrecks.

TABLE 3.—[1] *Expenditures under permanent indefinite appropriations provided by acts of June 14, 1880, and Mar. 3, 1899, for removing sunken vessels or craft obstructing or endangering navigation.*

Fiscal year ending June 30—		Fiscal year ending June 30—	
1881 1882	$8,574.58	1900	$37,345.39
1883	24,392.24	1901	47,582.00
1884	28,857.50	1902	43,797,28
1885	46,818.98	1903	51,312.70
1886	43,633.39	1904	80,652.05
1887	18,222.39	1905	69,960.77
1888	29,877.37	1906	76,451.60
1889	9,515.06	1907	52,083.87
1890	43,254.68	1908	50,380.08
1891	48,661.60	1909	49,828.85
1892	31,912.93	1910	49,522.41
1893	34,498.57	1911	83,520.41
1894	46,697.61	1912	64,848.74
1895	3,254.17	1913	115,208,81
1896	37,503.03	1914	108,872,42
1897	31,409.40	1915 (to Mar. 4)	72,173,19
1898	49,321,76	Total	1,668,237,57
1899	78,291,74		

Canal Operation.

TABLE 4.—*Expenditures under permanent indefinite appropriations provided by acts of Mar. 3, 1881, July 5, 1884, and Mar. 3, 1909, for operating and care of canals and other works of navigation.*

Fiscal year ending June 30—		Fiscal year ending June 30—	
1882	$132,201.28	1900	$846,538.18
1883	180,714.17	1901	849,689.03
1884	129,049.54	1902	1,019,256.31
1885	224,909.10	1903	1,091,515.05
1886	224,377.48	1904	1,101,510.27
1887	248,583.42	1905	1,145,644.82
1888	485,012.03	1906	1,108,710.29
1889	489,700.64	1907	1,441,390.88
1890	676,084.25	1908	1,588,330.89
1891	730,922.52	1909	1,700,458.77
1892	705,779.73	1910	1,889,687.31
1893	496,492.61	1911	1,923,517.11
1894	604,909.39	1912	2,222,709.71
1895	551,884.40	1913	2,222,906.87
1896	636,603.52	1914	2,162,235.38
1897	707,259.16	1915 (to Mar. 4)	1,791,367.88
1898	691,547.76		
1899	743,133.39	Total	32,764,633.14

Examination—South Pass.

TABLE 5.—*Expenditures under permanent annual appropriations provided by acts of Aug. 11, 1888, and June 13, 1902, for examinations and surveys at South Pass, Mississippi River.*

Fiscal year ending June 30—		Fiscal year ending June 30—	
1890	$10,000.00	1904	$9,135.39
1891	10,000.00	1905	10,231.79
1892	9,200.90	1906	11,087.14
1893	8,946.73	1907	8,929.88
1894	10,699.40	1908	10,450.00
1895	8,933.33	1909	9,050.00
1896	11,085.08	1910	11,000.00
1897	10,000.00	1911	10,320.00
1898	9,709.57	1912	8,680 00
1899	9,878.45	1913	11,490.00
1900	9,107.87	1914	9,375.00
1901	6,637.63	1915 (to Mar. 4)	6,390.00
1902	....		
1903	9,115.80	Total	239,953.96

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[1] The expenditures for each year represent the amounts drawn from the Treasury, less repayments.

Maintenance—South Pass.

Table 6.—*Expenditures under permanent annual appropriations provided by act of June 6, 1900, for maintenance by the United States of South Pass Channel, Mississippi River.*

Fiscal year ending June 30—	
1901	$29,974.87
1902	99,528.27
1903	108,861.20
1904	65,964.08
1905	105,214.12
1906	104,786.14
1907	99,888.74
1908	97,852.27
1909	93,089.78
1910	$100,848.59
1911	82,125.53
1912	78,234.60
1913	127,840.09
1914	96,077.24
1915 (to Mar. 4)	53,039.34
Total	1,213,821.72

Snagging and Dredging—Upper Mississippi.

Table 7.—*Expenditures under permanent annual appropriations provided by act of Aug. 11, 1888, for operating snag boats and dredge boats on Upper Mississippi River, as modified by the acts of Mar. 2, 1907, and Mar. 3, 1909, to include operations on the Illinois and Minnesota Rivers and other tributaries of the Upper Mississippi River.*

Fiscal year ending June 30—	
1890	$25,000.00
1891	25,000.00
1892	25,000.00
1893	25,000.00
1894	25,000.00
1895	25,000.00
1896	25,000.00
1897	25,000.00
1898	25,000.00
1899	25,000.00
1900	24,944.00
1901	25,000.00
1902	25,000.00
1903	25,000.00
1904	$25,000.00
1905	25,000.00
1906	25,000.00
1907	25,000.00
1908	25,000.00
1909	25,000.00
1910	25,000.00
1911	24,391.00
1912	23,442.40
1913	26,557.60
1914	24,475.15
1915 (to Mar. 4)	18,062.51
Total	641,872.68

Snagging and Wrecks—Mississippi River.

Table 8.—*Expenditures under permanent annual appropriations provided by act of Aug. 11, 1888, for removing snags and wrecks from Mississippi River, as modified by act of Mar. 3, 1909, to include Atchafalaya and Old Rivers, La.*

Fiscal year ending June 30—	
1890	$49,059.17
1891	92,720.97
1892	98,250.00
1893	96,497.23
1894	88,252.46
1895	100,000.00
1896	80,496.26
1897	83,421.64
1898	88,917.74
1899	88,923.15
1900	86,355.29
1901	86,710.05
1902	93,085,27
1903	72,587.48
1904	$88,245.25
1905	81,822.81
1906	85,662.36
1907	85,669.59
1908	97,889.35
1909	100,021.03
1910	96,782.04
1911	103,157.94
1912	97,978.58
1913	101,442.43
1914	99,856.30
1915 (to Mar. 4)	66,566.25
Total	2,310,370.64

Gauging—Mississippi and Tributaries.

TABLE 9.—*Expenditures under permanent annual appropriations provided by acts of Aug. 11, 1888, and June 13, 1902, for gauging the waters of Mississippi River and its principal tributaries.*

Fiscal year ending June 30—		Fiscal year ending June 30—	
1890	$8,323.53	1904	$7,086.61
1891	5,761.96	1905	9,942.14
1892	6,269.23	1906	7,750.86
1893	5,929.67	1907	7,189.00
1894	6,092.22	1908	9,251.10
1895	6,023.37	1909	8,888.49
1896	5,854.19	1910	8,794.87
1897	6,000.00	1911	8,744.71
1898	5,998.30	1912	8,727.23
1899	6,001.61	1913	9,072.25
1900	5,470.19	1914	8,586.83
1901	5,265.96	1915 (to Mar. 4)	4,270.15
1902	5,885.82		
1903	8,378.64	Total	185,559.02

Snagging—Ohio River.

TABLE 10.—*Expenditures under permanent annual appropriations provided by acts of Sept. 19, 1890, and June 3, 1896, for operating snag boats on Ohio River.*

Fiscal year ending June 30—		Fiscal year ending June 30—	
1891	$12,264.45	1905	$34,688.23
1892	25,135.55	1906	33,094.17
1893	23,178.13	1907	35,764.13
1894	24,849.27	1908	37,063.40
1895	20,782.19	1909	36,391.95
1896	30,216.90	1910	34,497.89
1897	27,739.80	1911	31,058.04
1898	18,426.83	1912	40,263.83
1899	28,987,78	1913	34,018.89
1900	37,079.05	1914	36,873.41
1901	43,385.12	1915 (to Mar. 4)	18,438.23
1902	42,004.14		
1903	32,655.08	Total	775,036.29
1904	36,229.83		

RECAPITULATION OF TOTAL APPROPRIATIONS BY ACTS.

Table 1	$802,772,723.23	Table 7	$641,872.08
Table 2	8,000,600.00	Table 8	2,310,370.64
Table 3	1,606,237.57	Table 9	185,559.02
Table 4	32,764,633.14	Table 10	775,036.29
Table 5	239,453.96		
Table 6	1,213,821.72	Total	[1] 850,551,708.25

[1] Includes all appropriations pertaining directly to the improvement of rivers and harbors, but does not include appropriations for prevention of deposits in New York Harbor, National Waterways Commission, International Waterways Commission, enlargement of Governors Island, Permanent International Association of Congresses of Navigation, U. S. Lake Survey, building for river and harbor instruction at U. S. Engineer School, and other appropriations not directly connected with the execution of river and harbor improvements.

PART B.

TABLE 11.—*Totals of river and harbor appropriations, by works of improvement or waterways, as detailed in this index, pages 28 to 1690.*

NOTE.—This table is not an attempt to arrange the appropriations by States, but by watershed districts. For example, District A contains waterways in both Maine and New Hampshire, and District B contains waterways in New Hampshire and Massachusetts. What might be termed the "New York districts" pertain to waterways in New York, Vermont, and New Jersey. The arrangement, in brief, is according to the natural situation of the waterways with respect to one another, rather than an arrangement within purely arbitrary State lines.

The simplest method of making the appropriations for the Mississippi, the Missouri, the Ohio, and the Columbia stand out clearly is to treat these waterways by themselves rather than in connection with any waterway district.

In considering the totals for Districts S, and from V-KK, the total for HH (Mississippi River) should be considered as connected therewith.

In considering the totals for Districts AA-FF, the total for CC (Ohio River) should be considered as connected therewith.

In considering the total for GG, it is to be remembered that it includes the total for the Missouri.

In considering the totals of Districts VV, WW, and XX, it is to be remembered that the total for the Columbia (p. 1616 of this index) should be considered therewith.

There should be pointed out that intracoastal waterways, as on the Atlantic coast and on the Gulf coast, might be considered apart from the waterway groups, as they serve a special purpose, like the Mississippi, the Ohio, the Missouri, and the Columbia, in linking or connecting waterways. The same might be said of St. Marys River, and of Detroit River, these two waterways linking together the various waterways of the Great Lakes in a special manner.

Nor should it be forgotten that harbors of refuge serve the commerce of the whole United States, with no reference to the benefit of a particular locality.

It should be pointed to, also, that in order to have an equitable consideration of some of the totals of the table below, some harbors should be considered as though they served not local but wholly national purposes. Some of these harbors are as follows:

Portland, Me.
Boston, Mass.
Newport, R. I.
New London, Conn.
New York, N. Y.
Philadelphia, Pa.
Wilmington, Del.
Baltimore, Md.
Norfolk, Va.
Wilmington, N. C.
Charleston, S. C.
Savannah, Ga.
Jacksonville, Fla.
Key West, Fla.
Tampa, Fla.
Mobile, Ala.
New Orleans, La.
Galveston, Tex.
Los Angeles, Cal.
San Francisco, Cal.
Portland, Oreg.
Seattle, Wash.
Honolulu, Hawaii.
San Juan, P. R.
Etc.

DISTRICT A.—PORTLAND, ME.

Page of this index.	Waterway.	Total.	Page of this index.	Waterway.	Total.
30	St. Croix R., Me	$80,000.00	40	Bucksport H., Me	$20,000.00
31	Cobscook B., Me	5,300.00	40	Stockton H., Me	38,000.00
31	Lubec Chan., Me	319,000.00	40	Carvers H., Me	45,000.00
32	Machias R., Me	32,000.00	41	Matinicus H., Me	14,000.00
32	Moosabec Bar, Me	114,000.00	42	Belfast B. and H., Me	62,000.00
33	Pleasant R., Me	3,500.00	43	Camden H., Me	102,400.00
33	Narraguagus R., Me	72,000.00	43	Rockport H., Me	47,000.00
34	Sullivan Falls H., Me	55,000.00	44	Rockland H., Me	925,500.00
35	Bar H., Me. (breakwater)	356,391.12	45	Owlshead H., Me	17,902.11
36	Union R., Me	190,950.00	46	Georges R., Me	26,000.00
37	Bagaduce R., Me	28,000.00	46	New H., Me	10,500.00
38	Penobscot R., Me	506,300.00	47	Damariscotta R., Me	5,000.00

Page of this index.	Waterway.	Total.	Page of this index.	Waterway.	Total.
47	S. Bristol H., Me	$3,500.00	59	Wells H., Me	$5,000.00
47	E. Boothbay H., Me	6,500.00	59	York H., Me	57,400.00
48	Boothbay H., Me	18,000.00	60	Piscataqua R., Me. and N. H	8,450.00
48	Kennebec R., Me	847,445.71	60	Portsmouth H., N. H	137,000.00
50	Richmond H., Me	20,000.00	61	Pepperells Cove, Me	95,000.00
50	Sasanoa R., Me	108,500.00	61	Cocheco R., N. H	311,771.00
51	Cathance R., Me	21,000.00	63	Bellamy R., N. H	35,000.00
52	Harraseeket R., Me	31,000.00	63	Lamprey R., N. H	20,000.00
53	Royal R., Me	30,000.00	63	Exeter R., N. H	63,200.00
53	Portland H., Me	1,506,477.05	64	Little H., N. H	145,000.00
55	Portland (Back Cove), Me.	116,250.00	65	Isle of Shoals H., Me. and N. H	84,000.00
56	Richmond Isld., Me	120,000.00			
56	Saco R., Me	406,775.00			
58	Cape Porpoise H., Me	126,000.00			
58	Kennebunk R., Me	91,675.00		Total	7,490,686.99

DISTRICT B.—BOSTON, MASS.

71	Newburyport H., Mass	$448,500.00	92	Dorchester B. and Neponset R., Mass	$124,233.00
72	Merrimac R., Mass. and N. H	395,366.72	93	Weymouth R., Mass	267,250.00
74	Powow R., Mass. and N. H	51,000.00	94	Town R., Mass	37,577.41
75	Lake Winnipiseogee, N. H	7,500.00	94	Hingham H., Mass	39,000.00
75	Ipswich R., Mass	7,500.00	95	Cohasset H., Mass	10,000.00
76	Essex R., Mass	30,000.00	95	Scituate H., Mass	104,680.00
76	Sandy B., Mass	1,950,000.00	96	Duxbury Beach and H., Mass	37,000.00
78	Rockport H., Mass	91,232.57	97	Kingston H., Mass	10,000.00
78	Gloucester H., Mass	542,083.00	98	Plymouth Beach and H., Mass	309,581.90
80	Manchester H., Mass	24,300.00	100	E. Dennis, Barnstable B., Mass	1,500.00
80	Beverly H., Mass	48,500.00	100	Wellfleet H., Mass	16,000.00
81	Salem H., Mass	65,000.00	101	Provincetown H., Mass	365,828.44
82	Marblehead, Mass	1,900.00	103	Chatham H., Mass	13,732.79
82	Lynn H., Mass	391,437.00			
84	Winthrop H., Mass	9,000.00		Total	17,860,649.98
84	Boston H., Mass	12,012,947.10			
90	Mystic R., Mass	258,005.12			
91	Mystic and Malden Rs., Mass	188,994.88			

DISTRICT C.—NEWPORT, R. I.

108	Nantucket Sound, Mass	$125,000.00	121	Newport H., R. I	$728,741.67
108	Bass R., Mass	20,150.41	123	Taunton R., Mass	213,250.00
109	Hyannis H. of Refuge, Mass	197,267.07	124	Fall R. H., Mass	368,912.00
110	Woods Hole H. and Chan., Mass	344,000.00	125	Warren R., R. I	5,000.00
111	Little H., Woods Hole, Mass	18,000.00	125	Providence R. and H., R. I	2,367,077.00
112	Canapitsit Chan., Mass	9,800.00	128	do	104,250.00
112	Vineyard Haven H., Mass.	60,000.00	128	Pawtucket R., R. I	506,584.00
113	Marthas Vineyard, Mass	30,000.00	130	Greenwich B., R. I	2,000.00
114	Nantucket H., Mass	525,161.50	131	Potonowut R., R. I	5,000.00
116	Buzzards B., Mass	2,500.00	131	Wickford H., R. I	16,300.00
117	Wareham H., Mass	96,236.00	132	Point Judith Pond, R. I.	20,000.00
117	New Bedford H., Mass	754,810.00	133	Point Judith, R. I	2,225,000.00
119	Westport H., Mass	3,000.00	134	Block Isld., R. I	242,500.00
119	Churches Cove H., R. I	28,200.00	135	Block Isld., R. I., H. of Refuge	588,500.00
119	Sakonnet R., R. I	40,000.00	137	Little Narragansett B., Conn. and R. I	36,000.00
120	Sakonnet Pt. H., R. I	39,000.00			
121	Coasters Isld. H., R. I	18,650.00		Total	9,740,889.65

DISTRICT D.—NEW LONDON, CONN.

Page of this index.	Waterway.	Total.	Page of this index.	Waterway.	Total.
142	Pawcatuck R., R. I. and Conn	$190,500.00	160	Milford H., Conn	$72,500.00
143	Stonington H., Conn	337,453.83	162	Housatonic R., Conn	310,150.00
145	Mystic R., Conn	40,100.60	163	Bridgeport H., Conn	938,500.00
145	New London H., Conn	178,800.00	166	Black Rock H., Conn	72,900.00
146	Thames R., Conn	539,400.00	167	Southport H., Conn	67,435.94
149	Connecticut R., Conn. and Mass	957,640.69	168	Westport H. and Saugatuck R., Conn	35,214.99
153	Westbrook H., Conn	130.00	169	Norwalk H., Conn	202,413.60
153	Eightmile R., Conn	9,000.00	170	Wilson Pt. H., Conn	55,000.00
153	Duck Isld. H., Conn	330,202.00	170	Fivemile R. H., Conn	47,000.00
154	Clinton H., Conn	8,500.00	171	Stamford H., Conn	180,360.53
155	Branford H., Conn	18,000.00	172	Coscob H. and Miamus R., Conn	19,000.00
156	New Haven H. and West R., Conn	836,773.90	173	Greenwich H., Conn	26,267.00
159	New Haven, Conn. (breakwater)	1,264,000.00		Total	6,737,241.88

DISTRICT E.—NEW YORK, NO. 1.

178	Port Chester H., N. Y	$146,500.00	202	Rouse Pt., Lake Champlain, N. Y	$98,500.00
179	Mamaroneck H., N. Y	69,500.00	203	Between North and South Hero Islds., Lake Champlain, N. Y	31,000.00
180	Larchmont H., N. Y	84,000.00	203	Gordons Landing, Lake Champlain, Vt	34,750.00
181	Echo B. H., N. Y	73,110.00	204	Plattsburg H., N. Y	216,180.01
182	New Rochelle H., N. Y	35,000.00	205	Ticonderoga R., N. Y	16,500.00
182	East Chester Creek, N. Y	159,500.00	206	Lake Champlain, N. Y. and Vt., Narrows	98,500.00
184	East R., N. Y. (see —— below)	6,015,700.00	207	Whitehall H., N. Y	33,000.00
187	Westchester Creek, N. Y	42,780.00	207	Otter Creek, Vt	62,500.00
188	Bronx R., N. Y	96,500.00	208	Burlington H., Vt	808,335.20
188	Harlem R., N. Y	1,838,000.00	210	St. Albans H., Lake Champlain, Vt	5,000.00
191	Hudson R., N. Y. and N. J	7,501,524.56	210	Swanton H., Vt	70,500.00
196	Tarrytown H., N. Y	36,000.00		Total	18,018,179.77
197	Peekskill H., N. Y	32,000.00			
198	Wappingers Creek, N. Y	25,500.00			
199	Saugerties H., N. Y	120,000.00			
200	Rondout H., N. Y	159,800.00			
202	Great Chazy R., N. Y	18,000.00			

DISTRICT F.—NEW YORK, NO. 2.

216	Flushing B., N. Y	$178,900.00	228	Sumpawanus Inlet, N. Y	$7,000.00
217	Hempstead H., N. Y	47,000.00	230	Jamaica B., N. Y	550,500.00
218	Glen Cove H., N. Y	72,000.00	230	Jamaica B. to Long Beach Inlet, N. Y	9,460.00
219	Huntington H., N. Y	63,000.00	231	Canarsie B., N. Y	75,750.00
221	Port Jefferson H., N. Y	186,356.35	232	Sheepshead B., N. Y	39,600.00
222	Mattituck H., N. Y	114,750.00	233	New York H., N. Y	12,746,590.00
224	Greenport H., N. Y	46,000.00	242	Newtown Creek, N. Y	480,900.00
224	Peconic R., N. Y	25,000.00		Total	14,904,606.35
225	Sag H., N. Y	59,800.00			
226	Great South B., N. Y	163,000.00			
227	Browns Creek, N. Y	39,000.00			

DISTRICT G.—NEW YORK, NO. 2.

Page of this index.	Waterway.	Total.	Page of this index.	Waterway.	Total.
247	Newark B., N. J..........	$12,000.00	260	South R., N. J............	$252,559.26
248	Hackensack R., N. J.....	50,000.00	261	Cheesequake Creek, N. J..	59,604.96
248	Passaic R., N. J..........	1,600,350.00	262	Keyport H., N. J..........	103,053.71
252	Raritan B., N. J..........	632,500.00	263	Matawan Creek, N. J.....	75,120.00
253	Arthur Kill, Staten Isld. Sound, etc..............	1,267,500.00	263	Shoal H. and Compton Creek, N. J............	65,502.81
256	Elizabeth R., N J.........	59,944.45	264	Shrewsbury R., N. J.....	429,500.00
257	Rahway R., N. J..........	37,000.00	266	Manasquan R., N. J......	46,000.00
257	Woodbridge Creek, N. J..	79,750.00			
258	Raritan R., N. J..........	791,182.81		Total..............	5,561,568.00

DISTRICT H.—PHILADELPHIA, PA.

271	Delaware R., N. J., Pa., and Del................	$18,320,103.61	290	Delaware Break'r, Del....	$5,652,347.70
288	Frankford Creek, Pa......	12,000.00		Total..............	24,509,451.31
288	Schuylkill R., Pa.........	525,000.00			

DISTRICT I.—WILMINGTON, DEL.

300	Cranberry Inlet, N. J.....	$1,000.00	314	Wilmington H., Del......	$1,496,852.00
300	Toms R., N. J.............	11,050.00	317	Chesapeake & Delaware Canal.....................	450,000.00
301	Double Creek, N. J.......	7,800.00	317	Appoquinimink R., Del..	62,100.00
301	Little Egg H. Inlet, N. J..	23,500.00	318	Smyrna R., Del...........	121,965.00
301	Tuckerton Creek, N. J....	73,380.00	319	Leipsic R., Del...........	38,100.00
302	Flatbeach or Tuckers Isld., N. J..............	100.00	320	Little R., Del.............	14,000.00
303	Atlantic City, N. J.......	195,000.00	320	St. Jones R., Del.........	108,850.00
303	Absecon Creek, N. J......	15,000.00	321	Murderkill R., Del........	82,860.00
304	Cold Spring Inlet, N. J...	961,200.00	322	Mispillion Creek, Del.....	175,650.00
305	Goshen Creek, N. J.......	17,000.00	324	Broadkill Creek, Del......	99,030.00
305	Dennis Creek, N. J.......	5,000.00	325	Rehoboth B. to Delaware B., Del............	50,000.00
305	Maurice R., N. J..........	88,000.00	325	Indian R., Del............	10,000.00
306	Cohansey Creek, N. J.....	101,300.00	326	Chincoteague B. to Delaware B................	195,250.00
307	Alloway Creek, N. J......	45,500.00	328	Delaware Line to Chincoteague Inlet, Md. and Va........................	2,170.64
308	Salem R., N. J............	80,300.00	328	Cat R. and Bogues B., Va.	12,100.00
309	Oldmans Creek, N. J.....	45,000.00		Total..............	4,916,007.64
310	Raccoon Creek, N. J......	69,500.00			
310	Mantua Creek, N. J.......	141,450.00			
311	Woodbury Creek, N. J....	7,500.00			
312	Cooper R., N. J...........	57,500.00			
313	Rancocas R., N. J........	45,000.00			
314	Chester and Ridley Creeks, Pa..............	6,000.00			

DISTRICT J.—BALTIMORE, MD.

Page of this index.	Waterway.	Total.	Page of this index.	Waterway.	Total.
340	Pocomoke R., Md. and Va.	$42,210.02	357	Queenstown H., Md	$56,558.02
341	Broad Creek, Md	57,200.00	357	Corsica R., Md	35,368.00
342	Crisfield H., Md	90,079.50	358	Rockhall H. and Inner H. at Rockhall, Md	86,471.72
342	Manokin R., Md	61,562.49	359	Fairlee Creek, Md	10,000.00
343	Deal Isld., Md. (Upper)	5,000.00	359	Worton (Creek) H., Md	12,000.00
343	Deal Isld., Md. (Lower)	12,300.00	360	Elk and Little Elk Rs., Md	108,008.00
344	Wicomico R., Md	127,516.00	361	Chesapeake to Delaware (Bs.) (ship-canal surs.)	51,000.00
346	Nanticoke R., Del. and Md	65,960.00	361	Northeast R., Md	20,640.00
347	Tyaskin Creek, Md	25,236.94	362	Susquehanna R., Md. and Pa	310,390.00
347	Broad Creek, Del	77,020.00	365	Battery Isld., Chesapeake B., Md	17,275.00
348	Twitch Cove and Big Thoroughfare R., Md	2,900.00	365	Chesapeake B. (headwaters of) and Havre de Grace H., Md	500.00
348	Slaughter Creek, Md	4,140.00	366	Baltimore H., Md	8,969,530.00
349	Choptank R., Md	91,946.17	369	Annapolis H. (South R.), Md	10,000.00
350	Cambridge H., Md	66,708.43		Total	10,642,435.50
351	Warwick R., Md	38,981.82			
352	Tuckahoe Creek, Md	15,600.00			
352	La Trappe R., Md	18,831.84			
353	Tred Avon R., Md	15,200.00			
354	Tilghman Isld. H., Md	7,820.00			
354	Claiborne H., Md	53,848.77			
355	Chester R., Md	74,632.78			

DISTRICT K.—WASHINGTON, D. C.

375	Patuxent R., Md	$14,000.00	395	Nomini Creek, Va	$96,000.00
376	St. Jerome Creek, Md	26,500.00	396	Lower Machodoc Creek, Va	11,180.00
377	Potomac R., Va., D. C., and Md	5,997,800.00	398	Dymers Creek, Va	9,000.00
387	Breton B., Md. (Leonardtown H.)	53,500.00	398	Rappahannock R., Va	565,145.97
389	Shenandoah R., Va. and W. Va	17,500.00	400	Carters Creek, Va	30,588.48
390	Accotink B. and Creek, Va	5,000.00	401	Totuskey R., Va	10,000.00
390	Occoquan Creek, Va	97,571.44	401	Urbana Creek, Va	66,000.00
392	Neabsco Creek, Va	5,000.00	403	Milford Haven, Va	28,000.00
393	Aquia Creek, Va	53,000.00	404	York R., Va	284,038.89
394	Upper Machodoc Creek, Va	23,200.00	405	Mattaponi R., Va	96,081.31
			406	Pamunkey R., Va	58,320.37
				Total	7,547,426.46

DISTRICT L.—NORFOLK, VA.

414	Cape Charles City H., Va.	$145,000.00	428	Nansemond R., Va	$100,000.00
415	Nandua Creek, Va	6,150.00	429	Elizabeth R., Va	455,080.00
416	Onancock (H. and) R., Va	34,011.00	430	Norfolk H., Va	3,710,282.00
417	Hampton Roads, Va. (Middle Ground Bar)	237,500.00	434	Norfolk to Cape Fear R., waterway	1,432,270.00
418	Hampton Roads, Va.—Ps., Jamestown Exposition	465,000.00	440	North Landing R., N. C. and Va	55,500.00
418	Hampton R. (Creek) and Bar, Va	22,000.00	441	Pasquotank R., N. C	7,090.00
419	James R., Va	3,125,500.00	442	Perquimans R., N. C	13,750.00
422	Archers Hope R., Va	10,000.00	442	Edenton B. and H., N. C	23,000.00
423	Jamestown Isld., James R., Va	40,000.00	444	Blackwater R., Va	22,000.00
423	Jamestown Isld., Va. (permanent landing p.)	15,000.00	444	Nottoway (Creek) R., Va	7,000.00
424	Chickahominy R., Va	29,000.00	445	Meherrin R., N. C	11,000.00
424	Appomattox R., Va. (from Petersburg to mouth)	853,830.00	445	Roanoke R., N. C. and Va	246,000.00
427	Pagan R. (Creek), Va	26,470.00	447	Staunton R., Va	52,500.00
			448	Dan R., N. C. and Va	50,500.00
				Total	11,195,423.00

DISTRICT M.—WILMINGTON, N. C.

Page of this index.	Waterway.	Total.
457	Mackays Creek, N. C	$15,000.00
457	Scuppernong R., N. C	32,000.00
458	Shallowbag (Manteo) B., N. C	14,750.00
459	Albemarle Sound, N. C., and Atlantic Ocean (communication between). (Croatan Sound)	65,000.00
459	Swan Quarter B. and Deep B., N. C. (waterway connecting)	14,575.00
460	Pamlico R., N. C	303,063.00
463	Fishing Creek, N. C	28,250.00
464	South R. (Creek), N. C	16,000.00
465	Bay R., N. C	22,000.00
465	Neuse R., N. C	386,250.00
467	Smiths Creek, N. C	16,250.00
467	Swift Creek, N. C	2,100.00
468	Contentnia Creek, N. C	81,000.00
469	Trent R., N. C	133,750.00
471	Pamlico Sound to Beaufort Inlet, N. C. (inland waterway via Adams Creek)	517,000.00
472	Beaufort H., N. C	230,676.00
476	Beaufort H., N. C., New R. to (waterway)	75,000.00
477	Newbern to Beaufort, N. C. (inland line of navigation between, via Clubfoot, Harlowe, and Newport Rs.)	$37,000.00
478	Beaufort Inlet, N. C., and waterways to or from	82,500.00
479	Cape Lookout, N. C. (H. of refuge at)	300,000.00
480	Ocracoke Inlet, N. C	238,750.00
481	Morehead City, N. C. (H. at)	20,000.00
482	New R. to Swansboro, N. C. (inland waterway)	36,830.80
483	New R., N. C	92,200.00
484	Cape Fear R., N. C	6,047,978.92
491	Northeast Cape Fear R., N. C	35,000.00
492	Lillington R., N. C	6,000.00
492	Black R., N. C	34,800.00
493	Town Creek, Brunswick County, N. C	9,500.00
494	Lockwoods Folly R., N. C	18,000.00
494	Shallotte R., N. C	3,000.00
	Total	8,914,223.72

DISTRICT N.—CHARLESTON, S. C.

501	Winyah B., S. C	$2,927,991.67
503	Waccamaw R., N. C. and S. C	222,700.00
504	Great Pedee R., N. C. and S. C	315,300.00
506	Little Pedee R., N. C. and S. C	46,700.00
507	Lumber R., N. C. and S. C	19,000.00
507	Yadkin R., N. C	107,000.00
508	Lynch R. and Clark Creek, S. C	2,000.00
509	Clarks (R.) Creek, S. C	7,500.00
510	Mingo Creek, S. C	41,600.00
511	Sampit R., Georgetown H., S. C	48,500.00
511	Santee R. (and Esterville-Minim Creek Canal), S. C	382,350.00
513	Wateree R., S. C	181,800.00
515	Congaree R., S. C	620,199.82
518	Charleston H., S. C., and Alligator Creek, opposite McClellanville, S. C. (inland waterways between)	211,290.00
519	Charleston H., S. C	$5,356,350.00
522	Charleston, S. C., and Beaufort, S. C. (inland waterway between)	50,000.00
523	Ashley R., S. C	5,500.00
524	Wappoo Cut, S. C	73,000.00
525	Town Creek, Cooper R., and Stono R., near Charleston, S. C. (removing obstrs.)	7,500.00
525	Edisto R., S. C	33,785.00
527	Ashepoo R., S. C	1,300.00
527	Salkehatchie R., S. C	18,000.00
528	Beaufort (Port Royal) R., S. C	33,000.00
529	Archers Creek, S. C	25,000.00
	Total	10,737,366.49

DISTRICT O.—SAVANNAH, GA.

Page of this index.	Waterway.	Total.
537	Savannah R. and H., Ga.	$11,118,563.58
546	Savannah, Ga., and Fernandina, Fla. (inside water route between)...	242,500.00
547	Savannah, Ocmulgee, Flint, and Choctawhatchee Rs............	10,000.00
547	St. Augustine Creek (Thunderbolt R.), Ga..	5,000.00
548	Cow Head (Cowhead Cut) R., Ga............	3,000.00
548	Skidaway Narrows, Ga...	55,000.00
548	Romerly Marsh, Ga. (water route through)......	42,108.77
549	Sapelo (R. and) H., Ga...	21,000.00
550	Darien H., Ga...........	281,161.36
552	Altamaha R., Ga.........	202,000.00
553	Oconee R., Ga...........	261,750.00
555	Ocmulgee (Okmulgee, Ockmulhee) R., Ga.....	441,500.00
558	Brunswick (St. Simons Sound) Outer Bar, Ga..	$310,000.00
558	Club and Plantation Creeks, Ga.............	40,700.00
559	Brunswick H., Ga........	1,039,900.00
561	Jekyl Creek, Ga..........	24,000.00
561	Satilla R., Ga............	10,000.00
562	Cumberland Sound and Fernandina, Ga. and Fla......................	3,607,500.00
565	St. Marys R., Ga. and Fla......................	19,450.00
566	St. Marys, Ga., and St. Johns, Fla. (inland passage between).......	78,000.00
	Total...............	17,813,133.71

DISTRICT P.—JACKSONVILLE, FLA.

572	Atlantic Ocean to the Gulf of Mexico (canal between)...............	$850,400.00
572	Florida, Louisiana, and Texas waterways (hyacinth removal)..........	331,580.00
575	Florida R. and H. imps..	70,000.00
575	St. Johns R. and Fernandina, Fla. (inside passage between)...........	7,000.00
575	St. Johns R., Fla.........	6,255,869.02
582	Oklawaha (Ocklawaha) R., Fla.................	88,710.00
584	St. Augustine H., Fla....	104,569.80
585	Indian R., Fla., and connecting waterways......	115,500.00
587	Biscayne B. (Miami), Fla.....................	662,500.00
589	Key West H., Fla. (including entrance thereto)....................	800,500.00
591	Caloosahatchee R., Fla...	174,500.00
592	Orange R., Fla...........	$6,100.00
593	Kissimmee R., Fla.......	32,821.00
594	Charlotte H. and Peace Creek (R.), Fla.........	126,000.00
595	Peace (Pease) R. (Creek), Fla......................	13,000.00
596	Tampa B. and Hillsboro B. and R., Fla..........	2,601,956.76
599	Sarasota B., Fla..........	110,000.00
600	Manatee R., Fla..........	155,108.37
601	St. Petersburg, Fla. (H. at)......................	32,000.00
602	Clearwater H. and Boca Ceiga B., Fla...........	70,000.00
603	Anclote B., H., and R., Fla......................	56,500.00
604	Crystal R., Fla...........	32,000.00
605	Withlacoochee R.. Fla....	319,100.00
606	Cedar Keys H., Fla.......	104,500.00
607	Suwanee R., Fla..........	90,658.00
	Total...............	12,419,872.95

DISTRICT Q.—MONTGOMERY, ALA.

612	St. Marks R., Fla.........	$37,530.00
612	Ocklockonee (Ochlockonee) R., Ga. and Fla....	5,000.00
613	Carrabelle Bar and H. (including East Pass), Fla.....................	194,204.08
614	Apalachicola B., Fla......	446,250.29
616	Apalachicola (including Chipola R.) R., Fla.....	181,250.00
618	Chattahoochee and Flint Rs., Ala., Fla., and Ga.	1,408,150.00
623	Gulf of Mexico, n. shore (waterway)............	3,000.00
623	Apalachicola R. and St. Andrews B., Fla. (chan. between)...............	320,008.00
623	St. Josephs B., Fla. (entrance to)................	$20,000.00
624	St. Andrews B., Fla......	203,560.00
624	Choctawhatchee B., including Santa Rosa Sound Chan., Fla.......	24,000.00
625	Choctawhatchee R., Fla. and Ala................	226,300.00
626	Holmes R., Fla. and Ala. (and Lagrange Bayou, Fla.)...................	23,000.00
628	Pensacola H., Fla........	1,355,956.94
630	Yellow R., Fla............	500.00
630	Blackwater R., Fla. and Ala: (including Blackwater and East Bs.)....	45,000.00

Page of this index.	Waterway.	Total.	Page of this index.	Waterway.	Total.
630	Escambia and Conecuh Rs., Fla. and Ala	$190,500.00	641	Oostenaula and Coosawattee Rs., Ga	$33,155.80
633	Alabama R., Ala	1,064,000.00	642	Cahaba R., Ala	45,000.00
635	Tallapoosa R., Ala. and Ga	44,000.00		Total	8,300,173.44
635	Coosa R., Ala. and Ga	2,428,516.33			
640	Etowah R., Ga	1,300.00			

DISTRICT R.—MOBILE, ALA.

647	Mississippi Coast Hs. (dr. for)	$200,000.00	668	Chickasahay R., Miss	$28,250.00
647	Mobile Bar, Ala	197,000.00	669	Leaf R., Miss	34,500.00
648	Mobile R. and H., Ala	7,031,630.60	669	Bluff Creek, Miss	1,000.00
651	Black Warrior, Warrior, and Tombigbee Rs., Ala. and Miss	8,883,832.20	670	Biloxi B. and H., Miss	82,000.00
662	Old Town Creek, Miss	3,000.00	671	Ship Isld. H. and Pass, Miss	40,000.00
663	Noxubee R., Ala. and Miss	62,000.00	672	Gulfport to Ship Isld. H., Miss. (chan. from)	874,199.85
664	Mobile B. and Mississippi Sound, Ala. (chan. connecting)	50,000.00	673	Wolf and Jordan Rs., Miss	40,000.00
664	Pascagoula R. and H., Horn Isld. H., and Horn Isld. Pass, Miss	1,255,830.00	674	Pearl R., Miss. and La	385,911.19
			678	Bogue Chitto, La	28,000.00
				Total	19,197,153.84

DISTRICT S.[1]—NEW ORLEANS, LA.

688	Lake Pontchartrain (including vicinity of Pass Manchac), La	$34,000.00	703	Grossetete Bayou, La	$18,000.00
689	Chefuncte (Tchefuncte) R. and Bogue Falia (Falaya), La	41,000.00	704	Courtableau Bayou, La	58,700.00
691	Tangipahoa R., La	11,500.00	705	Teche Bayou, La	427,200.00
691	Tickfaw R. (and tributaries), La	25,157.46	708	Vermilion Bayou, R., and Passes, La	62,100.00
693	Amite R. and Bayou Manchac, La	65,494.01	709	Inland waterway, Donaldsonville, La., to Rio Grande, Tex	501,792.00
694	Carondelet Canal, La	25,000.00	711	Mermentau (Mermenton) R. and tributaries, La	50,115.25
694	Homochitto R., Miss	24,000.00	712	Queue de Tortue Bayou, La	25,000.00
695	Plaquemine Bayou, La	2,026,917.34	712	Plaquemine Brule Bayou, La	12,800.00
699	Lafourche Bayou, La	270,000.00	712	Calcasieu Pass, Lake, and R., La	649,500.00
700	Terrebonne Bayou, La	73,800.00		Total	[1] 4,967,076.06
701	Atchafalaya B. and R., La	540,000.00			
702	Black Bayou	25,000.00			

[1] See note on p. 2287 of this index.

DISTRICT T.—DALLAS, TEX.

717	Sabine Lake, La. and Tex	$781,500.00	725	Trinity R., Tex	$1,805,305.92
719	Johnsons Bayou, La	9,500.00	729	Sulphur R., Tex. and Ark	45,988.99
719	Sabine R., La. and Tex	48,700.00	729	Jefferson, Tex., and Shreveport, La. (waterway)	100,000.00
721	Neches R., Tex. (including sur. of Angelina R., Tex.)	33,000.00	730	Cypress Bayou, La. and Tex	73,500.00
721	Port Arthur Canal, Tex. (operating and care)	309,069.53		Total	8,283,114.44
722	Sabine Pass H., Tex	5,076,550.00			

DISTRICT U.—GALVESTON, TEX

Page of this index.	Waterway.	Total.	Page of this index.	Waterway.	Total.
735	Sabine, Galveston, Pass Cavallo, Velasco, Brazos Santiago, and Corpus Christi Hs., and Sabine, Brazos, and Trinity Rs.	$7,000.00	754	West Galveston B., Tex.	$218,529.00
736	Galveston to Port Bolivar, Tex. (chan.)	241,080.00	755	Chocolate Bayou, Tex.	21,353.25
737	Galveston B. to Sabine Lake, Tex.	3,000.00	756	Bastrop Bayou, Tex.	18,730.29
737	East Bay Bayou, Tex. (including chan. across Hannas Reef)	3,299.67	756	Inland waterway, coast of Texas—West Galveston B. to Rio Grande R.	604,555.33
738	Double Bayou, Tex.	25,952.65	760	Oyster Creek, Tex.	10,000.00
739	Anahuac Chan., Tex.	24,100.00	760	Brazos R., Tex.	1,676.250.00
739	Turtle Bayou, Tex.	10,000.00	766	Colorado R., Tex.	20,000.00
740	Cedar Bayou, Tex.	52,750.00	767	Pass Cavallo to Port Lavaca, Tex. (chan.)	10,000.00
740	Galveston Ship Chan. and Buffalo Bayou, Tex.	3,597,326.85	767	Pass Cavallo H. and Inlet.	327,500.00
745	Clear Creek, Tex.	27,480.16	768	Guadalupe R., Tex.	232,700.00
746	Dickinson Bayou, Tex.	20,739.48	769	San Antonio R., Tex.	1,500.00
746	Galveston H. to Texas City, Tex. (chan.)	610,000.00	769	Aransas Pass, Tex.	2,653,750.00
747	Galveston, Tex.	13,803,000.00	773	Aransas Pass to Corpus Christi, Tex. (including Turtle Cove Chan.)	284,610.17
			773	Brazos Santiago H., Tex.	253,500.00
			775	Rio Grande R., Tex., Mex., and N. Mex.	21,735.00
				Total	24,780,441.85

DISTRICT X.[1]—VICKSBURG, MISS.

Page of this index.	Waterway.	Total.	Page of this index.	Waterway.	Total.
785	Pierre Bayou, Miss.	$5,000.00	807	Roundaway and Vidal Bayous, La.	$2,000.00
786	Big Black R., Miss.	15,000.00	807	Boeuf R., Ark. and La.	81,169.22
786	Yazoo R., Miss.	475,000.00	808	Bartholomew Bayou, Ark. and La.	79,000.00
788	Tchula Lake, Miss.	38,000.00	810	Saline R., Ark.	30,400.00
789	Yalobusha (Yallabusha) R., Miss.	11,000.00	810	Little Missouri R., Ark.	20,000.00
789	Tallahatchie and Coldwater Rs., Miss.	135,878.78	811	D'Arbonne and Corney (Cornay or Cornie R.) Bayous, La.	32,600.00
792	Bear Creek (branch of the Yazoo R.), Miss.	4,540.66	812	Little R., La.	2,500.00
792	Big Sunflower R., Miss.	307,365.51	812	Loggy Bayou, Lake Bistenau, and Lake Dorcheat, La.	5,000.00
794	Steele and Washington Bayous, and Lake Washington, Miss.	21,549.81	813	Pierre Bayou, La.	8,600.00
796	Red R., La., Tex., and Ark.	3,369,877.50	813	Cane R., La.	4,500.00
802	Black and Ouachita Rs., La. and Ark.	2,926,869.00		Total	[1] 7,648,350.48
806	Tensas R. and Bayou Macon, La.	72,500.00			

DISTRICT Y.[1]—LITTLE ROCK, ARK.

Page of this index.	Waterway.	Total.	Page of this index.	Waterway.	Total.
818	Arkansas R., Ark., Okla., and Kans.	$3,279,141.87	835	Current R., Ark. and Mo.	$59,835.00
825	Petit Jean R., Ark.	9,500.00	836	Little Red R., Ark.	8,405.14
826	Fourche Le Fevré R. (Fourche La Faive (Feve)), Ark.	33,500.00	836	St. Francis R., Ark. and Mo.	241,737.53
827	White, Black, Little Red, and St. Francis Rs., Ark.	236,500.00	839	Little R., Ark. and Mo. (from Homersville to its junction with the St. Francis)	8,000.93
829	White R., Ark.	1,509,499.32	840	L'Anguille R., Ark.	17,000.00
833	Cache R., Ark.	32,000.00		Total	[1] 5,643,769.79
834	Black R., Ark. and Mo.	208,650.00			

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[1] See note p. 2287 of this index.

DISTRICT AA.[1]—CHATTANOOGA AND NASHVILLE, TENN.

Page of this index.	Waterway.	Total.	Page of this index.	Waterway.	Total.
851	Wolf R., Tenn	$35,000.00	872	French Broad and Little Pigeon Rs., N. C. and Tenn	$185,000.00
851	Hatchee (Big Hatchie) R., Tenn	35,500.00	874	Holston R., Tenn. and Va	6,017.17
852	Obion R., Tenn	29,618.50	875	Clinch R., Tenn. and Va	61,825.43
853	Forked Deer R., Tenn	37,818.50	877	Elk R., Ala. and Tenn	4,000.00
855	Tennessee R., Ky., Tenn., and Ala	10,114,506.28	877	Duck R., Tenn	13,000.00
869	Mississippi to Atlantic. ("Transportation Routes to Seaboard," Tennessee R., Coosa R., Ocmulgee R., Altamaha R., and Hiwassee R.)	46,000.00	878	Cumberland R., Ky. and Tenn	5,225,715.54
870	Hiwassee (Hiawassee) R., Tenn	126,282.40	886	Caney Fork R., Tenn	28,000.00
871	Little Tennessee R., Tenn	7,000.00	887	Obey (Obeys) R., Tenn	11,500.00
			887	Cumberland R., Ky. (S. Fork)	12,000.00
			888	Red R., Tenn	5,000.00
				Total	[1] 15,983,783.82

DISTRICT BB.[1]—LOUISVILLE, KY.

891	Tradewater R., Ky	$16,500.00	898	Wabash R., Ill. and Ind	$902,858.02
892	Green and Barren Rs., Ky	2,388,888.79	902	White R., Ind	120,000.00
896	Rough R., Ky	125,362.74		Total	[1] 3,553,609.55

DISTRICT CC.[1]—FIRST CINCINNATI, OHIO.

912	Grand total of appropriations for Ohio R	$41,696,492.66			

DISTRICT DD.[1]—SECOND CINCINNATI, OHIO.

963	Kentucky R	$6,317,848.26	974	Muskingum R., Ohio	$2,273,675.79
967	Licking R., Ky	16,000.00		Total	[1] 10,530,000.48
969	Big Sandy R., Ky. and W. Va	1,922,476.43			

DISTRICT EE.[1]—WHEELING, W. VA.

985	Guyandot (Guyandotte) R., W. Va	$27,500.00	996	Elk R., W. Va	$31,000.00
986	Kanawha R., W. Va	5,561,647.03	997	Little Kanawha R., W. Va	595,941.86
994	New R., Va. and W. Va	112,000.00		Total	[1] 6,343,088.89
995	Gauley R., W. Va	15,000.00			

[1] See note on p. 2287 of this index.

DISTRICT FF.[1]—PITTSBURGH, PA.

Page of this index.	Waterway.	Total.	Page of this index.	Waterway.	Total.
1003	Monongahela R., Pa. and W. Va.	$11,773,201.00	1013	Pittsburgh H., Pa.	$168,662.90
1011	Buckhannon R., W. Va.	5,500.00	1014	Allegheny R., Pa.	2,651,624.68
1012	Cheat R., W. Va.	13,000.00		Total	[1] 14,721,988.58
1012	Youghiogheny R., Pa.	110,000.00			

DISTRICT GG.[1]—KANSAS CITY, MO.

1037	Missouri R., Mo., Kans., Nebr., Iowa, S. Dak., N. Dak., and Mont.	[1] $15,497,578.35	1062	Republican and Smoky Hill Rs. (Fort Riley Military Reservation), Kans.	$33,500.00
1060	Yellowstone R., N. Dak., Mont., and Wyo.	128,750.00	1063	Osage R., Mo.	1,035,000.00
1061	Wyoming and Colorado (arid regions)	5,000.00	1065	Gasconade R., Mo.	172,000.00
1062	Kansas R., Kans.	7,000.00		Total	[1] 16,878,828.35

DISTRICT HH.[1]—MISSISSIPPI RIVER.

1089	Grand total apps. for the Mississippi R.	[1]$148,992,955.71			

DISTRICT II.[1]—ST. LOUIS, MO.

1229	Kaskaskia R., Ill.	[1] $10,500.00			

DISTRICT JJ.[1]—ROCK ISLAND, ILL.

1235	Rock R., Ill. and Wis.	$1,000.00	1243	Cuivre R., Mo.	$12,000.00
1235	Illinois and Mississippi Canal, Ill.	8,653,311.56		Total	[1] 8,940,546.26
1241	Galena R., Ill.	273,234.70			
1243	Des Moines and Iowa Rs., Iowa	1,000.00			

DISTRICT KK.[1]—ST. PAUL, MINN.

1249	Chippewa R., Wis.	$208,214.86	1259	Otter Tail Lake and R., Red Lake and Red Lake R., Big Stone Lake and Lake Traverse, Minn. and S. Dak.	$13,000.00
1251	St. Croix Lake and R., Minn. and Wis.	158,565.00	1261	Warroad H. and R., Minn.	111,900.00
1253	Lake Minnetonka, Minn. (sur.)	7,000.00	1262	Zippel (R.) B., Minn.	27,781.00
1254	Minnesota R., Minn.	146,200.00		Total	[1] 1,063,293.86
1256	Red River of the North, Dak. and Minn.	383,123.00			
1259	Lake Traverse, Minn. and S. Dak.	7,510.00			

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[1] See note on p. 2287 of this index.

DISTRICT LL.—DULUTH, MINN.

Page of this index.	Waterway.	Total.	Page of this index.	Waterway.	Total.
1266	Grand Marais H., Minn	$174,350.00	1284	Ontonagon H., Mich	$423,500.00
1267	Grand Marais, Mich. (H. of refuge)	535,598.32	1286	Eagle H., Mich	97,000.00
1269	Agate B. H., Minn	260,852.88	1288	Keweenaw Waterway, Mich	2,049,814.21
1271	Duluth - Superior H., Minn. and Wis	7,317,648.69	1291	Marquette H., Mich	885,230.00
1280	Lake Superior to Mississippi R. (canal)	10,000.00	1293	Presque Isle Pt., Marquette B., Mich. (H. of refuge at)	62,500.00
1281	Port Wing H., Wis	69,992.00			
1282	Ashland H., Wis	569,500.00		Total	12,455,986.10

DISTRICT MM.—MILWAUKEE, WIS.

Page of this index.	Waterway.	Total.	Page of this index.	Waterway.	Total.
1297	Manistique H., Mich	$344,462.00	1322	Kewaunee H., Wis	$270,800.00
1298	Gladstone H. (Little Bay de Noc), Mich	14,000.00	1324	Two Rivers (East and West Twin Rs.) H., Wis	346,600.00
1299	Cedar R. H., Mich	30,000.00	1326	Manitowoc H., Wis	946,560.00
1300	Menominee H. and R., Mich. and Wis	427,420.00	1328	Sheboygan H., Wis	791,168.12
1302	Oconto H., Wis	171,000.00	1331	Port Washington (Ozaukee) H., Wis	241,400.00
1304	Pensaukee H. and R., Wis	16,000.00	1333	Milwaukee, Wis	2,473,975.36
1304	Green B. H., Wis	602,078.39	1337	Milwaukee and Rock R. Canal, Wis	225,276.83
1306	Fox and Wisconsin Rs., Wis	5,495,403.24	1338	South Milwaukee H., Wis	5,000.00
1315	Wolf R., Wis	1,500.00	1338	Racine H., Wis	808,719.67
1316	Lake Winnebago (Fox R.), Wis	3,900.00	1341	Kenosha (Southport) H., Wis	564,807.41
1317	Sturgeon B. and Lake Michigan Canal and H. of Refuge, Wis	978,917.42	1343	Waukegan H., Ill	690,500.00
1320	Ahnapee (Algoma) H. and R., Wis	354,000.00		Total	15,803,488.44

DISTRICT NN.—CHICAGO, ILL.

Page of this index.	Waterway.	Total.	Page of this index.	Waterway.	Total.
1349	Illinois R., Ill	$2,740,006.26	1367	Indiana H., Ind	$87,000.00
1356	Chicago H., Ill	3,636,005.00	1368	Michigan City H., Ind	1,824,338.92
1359	Chicago R., Ill	1,666,457.00	1371	Lake Michigan to Wabash R., Ind. and Ohio (canal)	2,000.00
1361	Calumet H., Ill	1,597,230.00	1372	New Buffalo H., Mich	83,000.00
1364	Calumet R. (including "Grand" Calumet R.), Ill. and Ind	1,273,500.00		Total	12,917,537.18
1366	Wolf Lake and R., Ill. and Ind. (Wolf Lake Cut; Wolf Lake Outlet)	8,000.00			

DISTRICT OO.—GRAND RAPIDS, MICH.

Page of this index.	Waterway.	Total.	Page of this index.	Waterway.	Total.
1378	St. Joseph H. and R., Mich	$926,063.00	1402	Ludington (Pere Marquette) H., Mich	$1,582,022.00
1382	South Haven H., Mich	500,300.00	1404	Manistee H., Mich	665,000.00
1385	Saugatuck H. and Kalamazoo R., Mich	550,939.00	1407	Portage Lake (Manistee County), Mich. (H. of refuge)	395,500.00
1388	Holland (Black Lake) H., Mich	770,767.31	1408	Arcadia H., Mich	40,000.00
1390	Grand Haven H., Mich	1,065,251.15	1409	Frankfort (Aux Becs Scies) H., Mich	506,274.85
1393	Grand R. (below Grand Rapids), Mich	513,000.00	1412	Charlevoix H. and Entrance to Pine Lake, Mich	226,500.00
1395	Muskegon H., Mich	881,500.00	1414	Petoskey H., Mich	145,500.00
1398	White Lake H. (White R. H.), Mich	373,550.00			
1400	Pentwater H., Mich	334,820.00		Total	9,476,987.31

DISTRICT PP.—DETROIT, MICH.

Page of this index.	Waterway.	Total.	Page of this index.	Waterway.	Total.
1420	Great Lakes ("Ship Chan. connecting Waters of the Great Lakes")	$3,365,000.00	1444	Black R., Port Huron at mouth, and vicinity of Black R. mouth in St. Clair R., Mich	$169,000.00
1422	St. Marys R. and St. Marys Falls Canal, Mich	23,464,591.68	1446	Pine R., at St. Clair City, Mich	15,560.00
1430	Mackinac H., Mich	60,000.00	1447	Belle R., Marine City (including ice H. of refuge), Mich	29,000.00
1431	Cheboygan H., Mich	198,500.00	1448	St. Clair Flats and Ship Canal, Mich	1,374,235.44
1432	Rogers City H., Mich	6,000.00	1451	Clinton R., Mich	89,564.00
1433	Alpena H. (Thunder B. R.), Mich	70,500.00	1452	Detroit R., Mich	11,899,500.00
1434	Ausable H. and R., Mich	113,970.00	1455	Rouge R., Mich	101,690.00
1435	Saginaw R., Mich	1,418,750.00	1457	Monroe H. (Raisin R.), Mich	262,015.27
1438	Sebewaing H. (R.), Saginaw B., Mich	59,000.00	1458	La Plaisance B., Mich	19,713.96
1441	Harbor Beach, Lake Huron, Mich. (H. of refuge)	2,053,500.00		Total	44,770,090.35

DISTRICT QQ.—CLEVELAND, OHIO.

Page of this index.	Waterway.	Total.	Page of this index.	Waterway.	Total.
1461	Toledo H. (Maumee B.), Ohio	$2,931,700.00	1472	Vermilion H., Ohio	$167,601.28
1464	Maumee R. (above Toledo), Ohio	7,000.00	1474	Lorain (Black R.) H., Ohio	1,218,204.77
1465	Wabash and Erie Canal, Ind. and Ohio	28,337.55	1477	Rocky R. H., Ohio	39,000.00
1465	Lake Erie to Ohio R. (canal through the State of Ohio)	20,119.47	1478	Cleveland H., Ohio	7,624,631.61
1465	Port Clinton H., Ohio	108,000.00	1482	Fairport H. (Grand R. H.), Ohio	1,206,107.71
1468	Sandusky R., Ohio	58,000.00	1485	Big (Cunningham Creek), Ohio	19,763.12
1468	Sandusky City H., Ohio	1,297,192.00	1485	Ashtabula H., Ohio	2,080,499.31
1471	Huron H., Ohio	561,773.71	1488	Conneaut H., Ohio	1,272,597.59
				Total	18,640,528.12

DISTRICT RR.—BUFFALO, N. Y.

Page of this index.	Waterway.	Total.	Page of this index.	Waterway.	Total.
1494	Erie H., Pa	$1,538,156.56	1520	New York Hs. (Hs. on the southern shore of Lake Ontario, between Genesee and Oswego Rs.)	$400.00
1498	Portland H., N. Y	56,616.00	1521	Pultneyville H., N. Y	85,000.00
1498	Dunkirk H., N. Y	1,089,112.38	1522	Great Sodus H., N. Y	607,784.80
1501	Cattaraugus Creek, N. Y	57,410.00	1524	Little Sodus B. H., N. Y.	530,441.77
1501	Buffalo and Black Rock Hs., N. Y	11,429,138.21	1526	Oswego H., N. Y	2,658,612.87
1509	Niagara R., N. Y	789,762.50	1531	Sandy Creek (Big), N. Y.	300.00
1512	Great Lakes to New York City ("Transportation Routes to Seaboard")	60,000.00	1531	Port Ontario H. (Salmon R.), N. Y	50,000.00
1513	Great Lakes, Ship Canal from, to the Hudson R. (sur.)	495,000.00	1532	Sacketts H., N. Y	20,000.00
1514	Wilson H., N. Y	74,750.00	1532	Black R., N. Y	45,401.00
1515	Olcott H., N. Y	179,500.00	1533	St. Lawrence R	116,000.00
1516	Oak Orchard H., N. Y	207,250.00	1534	Cape Vincent H., N. Y	164,000.00
1518	Charlotte H., mouth of Genesee R., N. Y	883,556.77	1536	Ogdensburg H., N. Y	536,938.29
			1537	Waddington H., N. Y	35,500.00
			1538	Grasse R., Massena, N. Y.	9,000.30
				Total	21,719,631.45

DISTRICT SS.—LOS ANGELES, CAL.

Page of this index.	Waterway.	Total.	Page of this index.	Waterway.	Total.
1543	Colorado R., Ariz., Cal., and Nev.	$35,000.00	1551	San Luis Obispo H., Cal	$522,660.00
1545	San Diego H., Cal	845,350.00		Total	7,156,260.00
1547	Los Angeles H., Cal	5,753,250.00			

DISTRICT TT.—FIRST SAN FRANCISCO, CAL.

1556	Pacific coast (H. of refuge)	$150,000.00	1565	San Pablo B., Cal	$875,168.41
1557	Monterey B. and H., Cal	200,000.00	1566	Napa R., Cal	58,929.36
1558	San Francisco H., Cal	515,927.84	1567	Petaluma Creek, Cal	131,898.00
1561	Alviso Creek, H., R., and Slough, Cal	58,000.00	1570	Humboldt H. and B., Cal	2,855,615.00
1562	Oakland H., San Francisco B., Cal	3,963.803.00	1572	Redwood Creek and H., Cal	43,800.00
1564	Suisun Creek (or Chan.), Cal	12,500.00		Total	8,865,641.61

DISTRICT UU.—THIRD SAN FRANCISCO, CAL.

1577	San Joaquin R., Cal	$1,006,065.00	1585	Sacramento and Feather Rs., Cal	$1,092,000.00
1580	California Débris Commission	1,470,124.09		Total	3,598,189.09
1584	Mokelumne R., Cal	30,000.00			

DISTRICT VV.[1]—FIRST PORTLAND, OREG.

1594	Oregon and Washington, coast of (dr. plant)	$100,000.00	1608	Nestucca R., Oreg	$6,000.00
1596	Coquille R., Oreg	442,000.00	1608	Tillamook Bar and B., Oreg	247,200.00
1599	Coos B. and H., Oreg	1,424,640.00	1610	Nehalem B. (Bar and R.), Oreg	110,000.00
1602	Coos R., Oreg	22,000.00	1611	Snake R., Oreg., Wash., and Idaho	45,000.00
1603	Umpqua R., Oreg	39,501.47	1612	Clearwater R., Idaho	50,000.00
1604	Siuslaw R. (and B. and Bar), Oreg	327,000.00		Total	[1] 3,531,341.47
1605	Alsea B., H., and R., Oreg	3,000.00			
1606	Yaquina B., Oreg	715,000.00			

DISTRICT WW.[1]—SECOND PORTLAND, OREG.

1616	Columbia R., Oreg., Wash., and Idaho	$22,710,257.68	1648	Long Tom R., Oreg	$3,500.00
1640	Youngs and Klaskuine (Klaskanine) Rs., Oreg	1,600.00	1649	Lewis R., Wash	30,350.00
1641	Clatskanie R., Oreg	19,200.00	1650	Cowlitz R., Wash	87,250.00
1642	Willamette R	1,080,500.00	1651	Grays R., Wash	3,500.00
1647	Yamhill R., Oreg	40,644.49		Total	[1] 23,976,802.17

[1] See note on p. 2287 of this index.

DISTRICT XX.[1]—SEATTLE, WASH.

Page of this index.	Waterway.	Total.
1657	Nasel R., Wash	$1,500.00
1657	Willapa (Shoalwater) R. and H., Wash	236,350.00
1659	Grays H., Wash	3,059,500.00
1661	Chehalis R., Wash	19,000.00
1662	Hoquiam R., Wash	12,000.00
1664	Puget Sound and its tributaries (Skagit, Stillaguamish, Nooksack, Snohomish, and Snoqualmie Rs.), Wash	510,000.00
1666	Puget Sound, Wash. (waterway to connect with Lakes Union, Sammamish, and Washington).	1,290,000.00
1667	Hammersley Inlet, Puget Sound, Wash	9,000.00
1668	Puget Sound, Wash. (inspection of fish traps)	35,000.00
1668	Olympia H., Wash	205,000.00
1669	Tacoma H., Wash	415,000.00
1672	Everett H., Wash	422,000.00
1673	Snohomish R., Wash	$181,500.00
1673	Skagit R., Wash	115,000.00
1674	Swinomish Slough, Wash.	225,000.00
1675	Bellingham B. and H., Wash. (including New Whatcom H., Fairhaven)	152,250.00
1676	Pend O'Reille R., Idaho and Wash	42,500.00
1677	Flathead R. and Pend O'Reille R., Mont	10,000.00
1678	Polson B., Flathead Lake, Mont	6,000.00
1678	Kootenai R., Idaho and Mont	10,000.00
1679	Okanogan R., Wash	40,000.00
1680	Portland Chan. (Canal), Alaska	5,000.00
1680	Yukon R., Alaska	130,000.00
1681	St. Michael Canal, Alaska.	391,000.00
	Total	[1] 7,522,600.00

[1] See note at head of this table.

DISTRICT YY.[1]—PORTO RICO, HAWAII, AND THE PHILIPPINES.

1687	San Juan H., Porto Rico	$777,500.00
1688	Honolulu H., Hawaii	975,000.00
1689	Honolulu, Hawaii (reclamation of Quarantine Isld)	20,000.00
1689	Pearl H., Hawaii	100,000.00
1690	Kahului H., Maui, Hawaii	$400,000.00
1690	Hilo H., Hawaii	1,026,000.00
	Total	[1] 3,298,500.00
	Grand total	720,051,987.93

[1] See note on p. 2287 of this index.

NOTE.—See p. 1691 for Manila H. app.

TABLE 12.—*Totals of river and harbor appropriations, by districts, as detailed in this index, pages 28 to 1690.*

District.	Offices.	Total.	District.	Offices.	Total.
A	Portland, Me	$7,490,686.99	BB	Louisville, Ky	$3,553,609.55
B	Boston, Mass	17,860,649.93	CC	(Ohio R.)	41,696,492.66
C	Newport, R. I	9,740,889.65	DD	Cincinnati, Ohio	10,530,000.48
D	New London, Conn	6,737,241.88	EE	Wheeling, W. Va	6,343,088.89
E	New York, N. Y	18,018,179.77	FF	Pittsburgh, Pa	14,721,988.58
F	New York, N. Y	14,904,606.35	GG	Kansas City, Mo	16,878,828.35
G	New York, N. Y	5,561,568.00	HH	(Mississippi R.)	148,992.955.71
H	Philadelphia, Pa	24,509,451.31	II	St. Louis, Mo	10,500.00
I	Wilmington, Del	4,916,007.64	JJ	Rock Isld., Ill	8,940,546.26
J	Baltimore, Md	10,642,435.50	KK	St. Paul, Minn	1,063,293.86
K	Washington, D. C	7,547,426.46	LL	Duluth, Minn	12,455,986.10
L	Norfolk, Va	11,195,423.00	MM	Milwaukee, Wis	15,803,488.44
M	Wilmington, N. C	8,914,223.72	NN	Chicago, Ill	12,917,537.18
N	Charleston, S. C	10,737,366.49	OO	Grand Rapids, Mich	9,476,987.31
O	Savannah, Ga	17,813,133.71	PP	Detroit, Mich	44,770,090.35
P	Jacksonville, Fla	12,419,872.95	QQ	Cleveland, Ohio	18,640,528.12
Q	Montgomery, Ala	8,300,173.44	RR	Buffalo, N. Y	21,719,631.45
R	Mobile, Ala	19,197,153.84	SS	Los Angeles, Cal	7,156,260.00
S	New Orleans, La	4,967,076.06	TT	San Francisco, Cal	8,865,641.61
T	Dallas, Tex	8,283,114.44	UU	San Francisco, Cal	3,598,189.09
U	Galveston, Tex	24,780,441.85	VV	Portland, Oreg	3,531,341.47
V	See District HH below.		WW	Portland, Oreg	23,976,802.17
W	See District HH below.		XX	Seattle, Wash	7,522,600.00
X	Vicksburg, Miss	7,648,350.48	YY	(Insular)	3,298,500.00
Y	Little Rock, Ark	5,643,769.79			
Z	See District HH below.			Grand total	730,277,914.70
AA	Chattanooga and Nashville, Tenn	15,983,783.82			

NOTE.—The grand total in this table is merely the total up to 1912 of the amounts reported by the district officers in their individual annual reports, and it is not, hence, to be compared with the grand total of Tables 1-10 ($850,551,708.25), which covers up to 1915, etc.

SPECIAL SUBJECTS.

REPORTS, CHIEF OF ENGINEERS, U. S. ARMY, 1866-1912.

SECTION 6.—ALPHABETICAL LIST OF ENGINEERS IN DIRECT CHARGE OF RIVER AND HARBOR WORKS.

NOTE.—The abstracts of reports on river and harbor works embraced within Part I (Rivers and Harbors) of this index give the names of the engineers in charge of each work under the subhead "In charge."

The following is an alphabetical list of those names. The list is so arranged that it shows the last title of the officer or engineer, the period within which he was probably in charge of river and harbor works, and the district or districts within which lie the river and harbor works reported upon by the officer. (See also p. 21 of this index.)

The districts in the last column are named in the order which indicates, approximately, the changes of station of the engineer in charge. It is desirable to lay emphasis on the fact that the last column does not contain a list of the districts of which the engineer named had charge; the list is of the districts embracing the waterways reported upon by the engineer officer, as those districts are shown now on the frontispiece map of this index. It should be borne in mind that with the growth of the work of the Corps of Engineers it was necessary to change the limits of the districts from time to time. As said at the beginning of this paragraph, however, the districts as named show approximately the order in which the engineer officer assumed charge of works throughout the United States.

Name of engineer officer.	Rank.	Period.	Reports, as engineer in charge, on waterways in the following districts.
Abbot, F. V	Col	1883-1912	HH, N, HH, KK, E, B, C.
Abert, J. J	Col	1844	RR.
Adams, E. M	Capt	1901-1910	S, T, HH, N.
Adams, H. M	Lt. Col	1871-1905	U, HH, D, E, F, G, HH, RR, T, HH, P, X, S, R.
Adams, M. B	Col	1873-1906	CC, RR, QQ, Y, E, AA, NN, OO, LL, MM.
Alexander, B. S	Lt. Col	1865-1874	A, SS, TT.
Allen, C. J	Lt. Col	1866-1903	RR, HH, KK, LL, GG, U, HH, II, L, K.
Altstaetter, F. W	Capt	1908-1912	CC, EE.
Anderson, J	Lt. Col	1827	D.
Bache, H	Maj	1839-1853	H.
Barden, W. J	Capt	1903	AA.
Barlow, J. W	Col	1871-1901	D, F, E, C, LL, MM, AA, G.
Barnard, J. G	Maj	1853	A, H.
Beach, L. H	Lt. Col	1888-1912	CC, LL, PP, HH, P, R, U, S.
Benham, H. W	Col	1849-1873	C, B.
Benyaurd, W. H. H	Lt. Col	1873-1900	X, T, Y, HH, AA, JJ, NN, SS, TT, UU, O, P, E, F.
Bergland, E	Capt	1884-1887	HH, AA, X.
Biddle, John	Col	1893-1911	AA, TT, SS, UU.
Bingham, T. A	Maj	1885-1903	GG, AA, RR.
Bixby, W. H	Col	1884-1910	M, N, L, D, C, B, CC, EE, DD, AA, DD, PP, JJ, NN, HH
Black, W. M	Col	1886-1912	Q, P, A, F, E.
Blunt, C. E	Col	1864-1886	E, B, RR, QQ, PP, A.
Boggs, F. C	Capt	1907-1908	CC, EE.
Bond, P. S	Lt	1904	RR.
Bowen, N	Maj	1869-1871	RR.
Brewerton, H	Maj	1834-1853	E, J.
Bromwell, Chas. S	Maj	1902-1911	T, P, R, S, HH, X, KK, MM, NN.
Brown, E. I	Maj	1907-1912	L, M, N, U.
Brown, Lytle	Capt	1908-1912	BB, CC.
Burgess, H	Maj	1903-1912	BB, CC, HH, P, S, AA.
Burnham, A. H	Capt	1871-1873	HH.
Burr, E	Lt. Col	1885-1910	XX, L, HH, A, B, E.
Canfield, A	Capt	1839-1853	RR, PP.
Caples, W. G	Lt	1907	AA.
Carter, O. M	Capt	1888-1897	O, Q.
Casey, T. L	Col	1884-1912	H, G, F, M, L, X, HH, J.
Cavanaugh, J. B	Maj	1903-1912	Q, R, P, VV, XX.
Cheney, S. A	Maj	1911-1912	UU, SS, TT.
Chittenden, H. M	Maj	1889-1908	GG, HH, KK, XX.
Comstock, C. B	Col	1877-1895	HH, Y.

Name of engineer officer.	Rank.	Period.	Reports, as engineer in charge, on waterways in the following districts.
Connor, W. D	Capt	1906–1908	HH, Y.
Cosby, Spencer	Maj	1902–1908	E, F, G, H, R, L, K.
Craighill, W. E	Lt. Col	1897–1912	M, EE, R, U, A.
Craighill, W. P	Col	1866–1895	J, K, M, L, EE, CC, L, EE.
Cram, T. J	Col	1864–1870	NN, MM, OO, QQ, RR, PP.
Crosby, O. T	Lt	1887	S.
Cuyler, J. W	Maj	1870–1883	LL, MM, NN, BB, DD, EE.
Damrell, A. N	Lt. Col	1870–1896	Q, R, P, A.
D'Armit, A. M	Lt	1892–1893	P.
Davis, C. E. L. B	Col	1876–1908	U, T, MM, LL, KK, L, K, J, TT, UU, SS, YY, PP.
Deakyne, Herbert	Maj	1898–1912	UU, P, I, H.
Delafield, R	Maj	1836–1852	H, E.
Derby, G. McC	Lt. Col	1886–1907	G, HH, CC, BB, KK.
Dutton, George	Capt	1852–1853	D, C.
Elliot, G. H	Lt. Col	1882–1887	C, D.
Ernst, O. H	Col	1880–1906	GG, HH, II, U, HH, J, NN, HH.
Farquhar, F. U	Maj	1866–1883	RR, OO, LL, JJ, GG, HH, KK, CC, PP.
Ferguson, H. B	Capt	1908–1911	Q.
Fieberger, G. J	Capt	1889–1892	K, L.
Fisk, W. L	Lt. Col	1888–1911	X, T, HH, S, LL, WW, VV, B, A, PP, RR.
Fitch, G. D	Lt. Col	1895–1912	HH, RR, Y, LL, Q, P.
Flagler, C. A. F	Maj	1899–1912	Q, I, YY, R, AA.
Foster, J. G	Lt. Col	1867–1871	B, C.
Frazer, W. D	Maj	1853–1854	E.
Fries, A. A	Capt	1906–1909	SS.
Gaillard, D. D	Capt	1897–1902	XX, LL.
Gillespie, G. L	Col	1870–1901	QQ, RR, PP, NN, WW, VV, XX, G, E, F, B, HH.
Gillette, C. E	Capt	1891–1904	CC, SS, TT, UU, O, C.
Gillmore, Q. A	Col	1869–1888	P, N, O, Q, HH.
Goethals, G. W	Maj	1885–1902	DD, CC, AA, C.
Graham, J. D	Col. (Top. Engrs.)	1854–1867	MM, OO, NN, RR, PP, QQ, E, A, H, D, B, J, C, F, I, D.
Greene, B. O	Lt	1870–1871	RR.
Gregory, J. F	Maj	1876–1910	U, LL, KK, MM, DD, EE, BB.
Griffith, J. E	Lt	1869–1872	HH.
Guthrie, W. L	Lt	1909–1911	RR.
Hains, P. C	Col	1867–1902	HH, K, L, A, EE, J.
Handbury, T. H	Lt. Col	1881–1905	Y, X, T, JJ, NN, XX, WW, P, II, HH, SS, UU.
Hannum, W. T	Capt	1910	K, L.
Harding, C	Capt	1895–1901	HH, LL, NN, OO.
Harrison, M	Lt	1853	F.
Harts, W. W	Maj	1898–1911	WW, VV, UU, TT, AA.
Harwood, F	Maj	1867–1883	RR, QQ, PP, LL, OO, C.
Haupt	Lt	1869	U.
Heap, D. P	Lt. Col	1882–1903	LL, OO, A, M, UU.
Heuer, W. H	Col	1865–1906	HH, T, H, I, J, X, S, UU, TT, CC, DD, SS, YY, SS.
Hinman, F. A	Capt	1883–1887	LL, MM, N, L, M.
Hodges, H. F	Capt	1892–1901	GG, CC, DD, EE.
Hodges, J. N	Lt	1912	HH, KK, LL.
Hoffman, G. M	Capt	1905–1907	X, HH.
Houston, D. C	Col	1866–1892	D, C, B, LL, NN, MM, KK, E, F.
Howell, C. W	Maj	1867–1903	HH, X, T, R, S, U, HH.
Howell, G. P	Maj	1901–1912	HH, U, N.
Howell, R. P	Capt	1912	S.
Hoxie, R. L	Lt. Col	1885–1908	P, O, Q, FF, A, KK, HH, J, K, J.
Hughes, G. W	Capt	1843	E.
Ives, J. C	Lt	1857–1858	SS.
Jackson, T. H	Capt	1901–1912	A, UU, U, X, T.
Jadwin, Edgar	Maj	1901–1912	SS, TT, U, AA.
Jervey, H	Lt. Col	1898–1912	HH, P, R, Q, CC, BB.
Jewett, H. C	Lt	1906–1907	A.
Johnston, J. E	Lt	1839	RR.
Johnston, R. P	Capt	1901–1906	UU, L, M.
Jones, W. A	Col	1868–1903	RR, WW, XX, VV, GG, HH, KK, J.
Judson, W. V	Maj	1901–1909	Q, KK, MM.
Kearney, J	Lt. Col	1854–1876	MM, L.
Keller, Chas	Maj	1895–1912	HH, NN, OO, LL, PP, MM, JJ, HH.
King, W. R	Lt. Col	1875–1897	Q, AA, O, JJ, HH.
Kingman, D. C	Col	1886–1912	HH, S, RR, AA, PP, QQ, O, P, N, O.
Knight, C. H	Lt	1908–1910	HH.
Knight, J. G. D	Col	1882–1909	HH, AA, F, E, F.
Kuhn, Jos. E	Maj	1907–1909	L.
Kurtz, J. D	Lt. Col	1870–1877	H, I, G, I.
Kutz, C. W	Maj	1898–1911	J, A, XX.
Ladue, W. B	Capt	1903–1906	HH.
Langfitt, W. C	Lt. Col	1894–1912	CC, WW, VV, K, L, J.
Leach, S. S	Lt. Col	1879–1906	HH, E, RR, D, L, K.
Lee, A. N	Capt	1878–1879	CC.
Leeds, C. T	Capt	1909–1911	SS, UU, TT.
Linnard, T. B	Lt	1839	H.
Livermore, W. R	Col	1880–1907	U, C, D, G, E, F.

Name of engineer officer.	Rank.	Period.	Reports, as engineer in charge, on waterways in the following districts.
Lockwood, D. W	Col	1877–1910	HH, PP, OO, NN, FF, DD, EE, BB, D, C, B, HH, KK, LL, E, G.
Long, S. H	Col	1837	A.
Lucas, E. W. Van C	Capt	1899–1905	M, L, HH.
Ludlow, W	Col	1871–1899	N, I, H, J, LL, NN, OO, PP, E, F.
Lukesh, G. R	Capt	1906–1909	HH, Y.
Lusk, J. L	Lt. Col	1884–1906	P, JJ, HH.
Lydecker, G. J	Col	1877–1901	NN, JJ, BB, NN, OO, LL, PP, CO.
Mackenzie, A	Maj	1878–1895	CC, PP, JJ, HH.
Macomb, J. N	Col	1856–1882	PP, HH, GG, KK, JJ, H, I, G, J.
Maguire, E	Capt	1877–1891	GG, QQ, RR, BB, CC.
Mahan, F. A	Maj	1878–1899	CC, RR, Q.
Mallery, J. C	Maj	1892	P.
Mansfield, J. K	Lt	1835–1837	M, O.
Mansfield, S. M	Col	1868–1903	SS, OO, LL, T, U, B, NN, C, UU, QQ, E, F, G, E.
Marshall, W. L	Col	1882–1908	HH, KK, LL, MM, JJ, NN, E, F.
Maurice, T. W	Capt	1821–1829	RR.
McAlester, M. D	Maj	1866–1869	HH, S, RR.
McClellan	Capt	1839–1853	M, U.
McFarland, W	Lt. Col	1868–1889	QQ, RR, PP, Q, AA, O, DD, E, D, F, G, F.
McGregor, R	Lt	1899–1900	Y.
McIndoe, J. F	Maj	1894–1910	GG, X, T, P, R, HH, S, VV, WW.
McKinstry, C. H	Lt. Col	1898–1912	P, O, UU, SS.
Meade, G. G	Capt	1859	OO.
Mendell, G. H	Col	1866–1895	B, SS, TT, UU.
Mercur, J	Capt	1877–1886	E, G, L, M, N, K, F.
Merrill, W. E	Lt. Col	1866–1887	R, NN, CO, DD, HH, FF, EE, BB, EE.
Meyler, J. J	Capt	1899–1901	SS.
Michler, N	Lt. Col	1867–1883	K, WW, VV, XX, PP, QQ, E, G.
Miller, A. M	Col	1882–1904	AA, HH, X, S, T, GG, BB, II, U, E, G, K, L.
Millis, John	Lt. Col	1890–1912	HH, XX, QQ.
Morrow, J. J	Maj	1909–1912	L, K, WW, VV.
Newcomer, H. C	Lt. Col	1897–1912	HH, AA, FF, CC.
Newton, J	Col	1866–1884	E, G, F.
Oakes, J. C	Maj	1907–1912	U, DD, EE.
Otwell, C. W	Capt	1905–1909	A, YY.
Overman, L. C	Maj	1874–1892	Q, RR, PP, QQ.
Palfrey, C. F	Capt	1886–1895	RR, HH, Y, KK, MM.
Parke, J. G	Maj	1867–1868	J.
Patrick, M. M	Lt. Col	1898–1912	HH, L.
Payne, D. W	Lt	1868–1869	HH.
Payson, A. H	Capt	1885–1887	UU, SS, TT.
Phillips, C. B	Capt	1872–1883	J, L, M, N.
Pillsbury, G. B	Capt	1907–1908	XX.
Poe, O. M	Col	1870–1892	PP, MM, GG, LL, KK.
Post, J. C	Maj	1883–1895	O, BB, DD, EE, P, JJ, FF, WW.
Potter, C. L	Lt. Col	1896–1912	SS, HH, X, T, LL, YY, HH.
Powell, C. F	Lt. Col	1878–1905	HH, WW, VV, XX, HH, GG, FF, D.
Prescott	Lt	1828	C.
Price, P. M	Capt	1879–1893	HH, Q.
Prime, F. E	Maj	1868–1869	HH.
Putnam, A. B	Capt	1908–1912	AA, YY.
Quinn, J. B	Col	1882–1907	HH, GG, LL, S, T, U, L, O, P, KK.
Rand, L. H	Capt	1908–1912	I, M.
Raymond, C. W	Lt. Col	1883–1904	B, HH, J, I, H, G.
Raymond, R. R	Maj	1902–1912	Q, I.
Raynolds, W. F	Lt. Col	1866–1873	PP, LL, GG, HH, Y, X, JJ, Q, R, P.
Rees, T. H	Lt. Col	1900–1912	P, NN, KK, MM, TT, UU.
Reese, C. B	Maj	1865–1870	E, RR, Q, R.
Rhett, E. M	Lt	1901–1902	P.
Riche, C. S	Maj	1899–1912	U, JJ, HH, LL, MM, OO.
Robert, H.	Col	1871–1899	WW, VV, LL, MM, E, RR, J, H, I, AA, D, F, U.
Roessler, S. W	Col	1890–1912	HH, A, VV, WW, G, F, YY.
Rossell, W. T	Col	1881–1912	A, P, Q, HH, R, CC, HH, G.
Ruffner, E. H	Col	1892–1909	RR, N, E, F, G, BB, EE, DD, CC, HH, S, P.
Sanford, J. C	Lt. Col	1899–1910	GG, N, I, J, H, C.
Schulz, E. H	Maj	1904–1912	E, F, HH, KK, GG.
Sears, C. B	Col	1884–1908	HH, GG, LL, AA, HH, S, YY, HH.
Sherrill, C. O	Capt	1912	HH.
Shunk, F. R	Lt. Col	1903–1912	P, KK, HH, LL.
Sibert, W. L	Maj	1895–1906	Y, BB, CC, FF.
Simpson, J. H	Col	1868–1880	J, P, M, R, Q, Y, X, HH, GG.
Sitgreaves, L	Lt. Col	1865–1866	NN, MM.
Slattery, J. R	Capt	1905–1912	YY, P.
Smead, R. C	Lt	1833–1836	RR.
Smith, C. S	Maj	1908–1911	X, HH, Y.
Smith, H	Capt	1834	PP.
Smith, H. L	Lt	1853	T.
Smith, J. A	Col	1867–1904	B, C, BB, NN, JJ, A, PP, QQ, UU, H, I, J, L.
Smith, J. L	Capt	1836	RR.
Smith, Wm	Capt	1827	RR.
Spalding, G. R	Capt	1908–1912	PP, P.

Name of engineer officer.	Rank.	Period.	Reports, as engineer in charge, on waterways in the following districts.
Stansbury, H	Capt	1831–1856	NN, QQ.
Stanton, W. S	Col	1867–1907	U, L, M, N, RR, A, B, E.
Stewart, C. S	Col	1866–1887	H, UU, TT, SS.
Stickle, H. W	Maj	1911–1912	M, L.
Stickney, A	Col	1880–1904	R, S, HH, DD, BB, RR, FF, CC, HH, GG, F, E.
Stokey, W. P	Capt	1910–1912	SS.
Stuart, E. R	Capt	1908	N.
Suter, C. R	Col	1867–1901	HH, AA, GG, Y, HH, TT, UU, B.
Swift, A. J	Lt	1836–1838	M.
Swift, W. H	Capt	1836–1838	D.
Symons, T. W	Maj	1890–1902	VV, XX, RR.
Taber, H. S	Capt	1885–1893	X, Y, T.
Tardy, J. A	Capt	1865–1868	RR.
Taylor, H	Lt. Col	1895–1910	WW, VV, XX, A, B, E, C, D.
Thayer, S	Lt. Col	1852	B.
Thom, G	Col	1866–1886	A, C, B.
Totten, J. G	Col	1827–1836	C, B.
Townsend, C. McD	Col	1891–1912	HH, LL, NN, OO, HH, JJ, QQ, PP, HH.
Turnbull, Wm	Col	1842–1859	E, RR, M, L.
Turtle, T	Capt	1873–1894	K, CC, J, I, S, T, HH, X, EE, L.
Waldron, A. E	Capt	1908–1912	T, X, U, D.
Walker, M. L	Maj	1901–1911	U, Y, HH, X.
Warren, G. K	Lt. Col	1866–1882	HH, KK, F, C, D, B.
Warren, J. G	Lt. Col	1893–1912	HH, BB, KK, MM, LL, NN, OO, DD, CC, EE, RR.
Waterman, H. E	Capt	1895–1898	HH.
Webster, J. D	Lt	1848–1854	NN.
Weitzel, G	Lt. Col	1867–1884	CC, AA, BB, PP, H, I, J.
Wellman, D. W	Capt	1878	Y.
Wheeler, G. M	Lt	1876	SS.
Wheeler, J. B	Maj	1866–1870	OO, MM, NN, LL.
Whipple, A. N	Capt	1859	PP.
Whiting, W. H. C	Lt	1856–1859	M, L.
Willard, J. H	Lt. Col	1886–1907	AA, X, HH, S, T, NN, JJ, SS, C.
Williams, Arthur	Capt	1910	VV, WW.
Williams, W. G	Capt	1839	RR.
Williamson, R. S	Lt. Col	1866–1871	TT, WW, SS, UU, VV.
Willing, W	Lt	1908	HH.
Wilson, J. H	Lt. Col	1866–1871	HH, JJ.
Wilson, J. M	Maj	1870–1883	RR, WW, XX, VV, PP, QQ.
Winder, John H	Lt	1838	M.
Winslow, E. E	Maj	1899–1910	HH, M, L, YY.
Woodbury, D. P	Capt	1853–1859	M, L.
Woodruff, E. A	Lt	1871	S.
Woodruff, I. C	Lt. Col	1856–1872	RR, I, QQ.
Woodruff, J. A	Capt	1911	X, HH.
Wooten, W. P	Maj	1905–1912	X, T, U, YY.
Wright, H. G	Lt	1853	P.
Young, W	Capt	1888–1890	WW, VV, HH.
Zinn, G. A	Lt. Col	1893–1912	HH, KK, MM, DD, BB, CC, EE, A, NN, JJ, KK.

SPECIAL SUBJECTS.

REPORTS, CHIEF OF ENGINEERS, U. S. ARMY, 1866-1912.

SECTION 7.—ALPHABETICAL LIST OF CONTRACTORS ON RIVER AND HARBOR WORK, 1901-1912.

NOTE.—The Chief of Engineers reports in his annual reports what contracts have been entered into for public works during the fiscal year. In Part I (Rivers and Harbors) of this index these contracts are referred to under the subtitle "Contracts," the arrangement being according to time only.

As it is often important to know something of the experience of a contractor, without making an extended reference to office files, or having recourse to correspondence with various offices, the following list of contractors on river and harbor work has an obvious value.

The list is composed only of those contracts or contractors reported in the period 1901-1912, it being doubtful if the value of the list would be increased by listing contracts prior to 1901.

The names of contractors are arranged alphabetically. The approximate number of contracts is given, and then follows a brief reference to the nature of the work done. The final column names the districts within which the work was done. The address of the office of a district is printed at the beginning of the abstracts of a waterway group in Part I of this index. A glance through the contracts in the abstracts of a waterway group (pp. 23-1691 of this index) furnishes details concerning prices, etc., and furnishes also the volume and page reference to those reports which give the contract details completely.

Contractor.	Approximate number of contracts.	For—	For works in districts—
Abadie Co., E. H	1	Engines and pumps	HH.
Abel. (See Rodgers.)			
A. B. Electric Co	1	Electric-light plant	HH.
Acme Boiler & Construction Co	1	Pontoons	HH.
Acme Lumber Co	1	Piles for lock	S.
Adams, A. W	1	Stone	RR.
Adams & Duford Co	1	do	RR.
Aderholt & Lawrence	1	Levees	HH.
Advance Sand & Construction Co	1	Dam work	CC.
Ætna Construction Co	5	Land wall; slopes; paving; lock for movable dam; navigable pass; riprap stone.	CC.
Ætna Foundry & Machine Co	2	Castings; lock parts	CC.
Aiken, A. C	1	Dredging	TT.
Albrecht. (See Schoellhorn.)			
Alexander. (See Eskald.)			
Allbright & Ferrill	1	Riprap stone	Y.
Albright & Ramsey	1	do	Y.
Allen. (See Penn.)			
Allis-Chalmers Co	2	Electric plant; rock crusher	CC.
Alma Cement Co	3	Cement	DD.
Alpena Portland Cement Co	2	do	LL, PP.
Alpha Portland Cement Co	2	do	Y, PP.
American Bridge Co	14	Steel; dam trestles; flatboats; barges; lock parts; lock gates; iron and steel parts.	CC, DD, FF, HH.
American Compressor & Pump Co	1	Machinery	FF.
American Creosote Works	1	Piles, etc	U.
American Dredging Co	18	Dredging; bulkheads	D, H, I.
American Hoist & Derrick Co	2	Derricks; engines	CC, PP.
American Paving & Construction Co	11	Dredging	J.
American Pile Driving Co	1	Dikes	XX.
American Steel & Wire Co	1	Cables, electric	PP.
Anderson. (See Johnson.)			
Anderson, John	3	Dredging	R, S.
Anderson-Murphy Co	1	Rock removal	E.
Anderson, Wm	1	Wreck removal	RR.
Anderson, Z. T	1	Levees	HH.
Antioch Dredging Co	1	Dredging	UU.
Armstrong, Chas	1	Barge hire	DD.
Arnold. (See Frederick.)			
Associated Oil Co	2	Oil	WW.

Contractor.	Approximate number of contracts.	For—	For works in districts—
Astoria Iron Works	1	Boiler	WW.
Atlantic Dredging Co	17	Dredging; dams; bridges; piers; flumes; pipe laying; enrockment.	D, G, L.
Atlantic, Gulf & Pacific Co	12	Dredging; dikes; barriers	H, K, N, O, R, TT, UU, YY.
Atlantic Machine Works	1	Metal work	AA.
Atlas Dredging Co	4	Dredging	I.
Atlas Portland Cement Co	12	Cement	CC, DD, EE.
Avery Planting & Improving Co	1	Sand and gravel	S.
Axman, Rudolph	2	Rock removal; dredging	TT.
Babcock, A. E	1	Jetty work	SS.
Bair & Gazzam Mfg. Co	1	Machinery	FF.
Baker & Egan	1	Building dam	CC.
Baker & Judson	2	Lock and dams, stone	FF.
Baker Construction Co	5	Building Chanoine dam; removing bear trap gate; movable dam; constructing guide and retaining walls; constructing lock.	CC, DD.
Baker, E. Brown	1	Building dam	CC.
Baker Iron Works	1	Discharge pipe	SS.
Baldwin & Co., A	1	Steel	S.
Ball-Carden Co	1	Constructing lock and dam	T.
Baltimore Bridge Co	1	Leaves for lock gate	AA.
Baltimore Construction Co	1	Constructng bulkhead	H.
Banfield, M. C	1	Hire and lease of dock	WW.
Bangs. (See Hughes.)			
Banks. (See Kruse.)			
Barker, George G	3	Dredging	R.
Barnes Co., The Chas	3	Snag boat; constructing towboats; cast-iron pipe for snag boat.	U, CC.
Barrett, O. F	13	Constructing flatboat; constructing stone dam; extension and repair of dikes; building dike; scows; stone, levee work.	CC, FF, HH.
Barrie, B	1	Piles	UU.
Barristers Hall, trustees of	1	Office rent	B.
Barr, J. Carrol	1	Building concrete foundations for lock keeper's houses.	CC.
Barton. (See McHarg.)			
Bates, Jennie S	1	Rent of office room	UU.
Bateson & Co., W	2	Structural steel; air compressors; winches.	CC.
Baumann & Co., J. A	1	Excavating and constructing outlet for settling basin.	UU.
Bay & River Dredging Co	5	Dredging	TT, UU.
Bayard, M. L	1	Power house and machinery	CC.
Bay State Dredging Co	24	Dredging	A, B.
Beans, J. H	2	Iron castings; iron casting for dam.	CC.
Beard, W. H	1	Dredging, Coney Isld. Chan	F.
Beattie, John, estate of	2	Stone, in breakwater	D.
Beattie, Peter, and John Beattie, jr., executors.	1	Building breakwater	F.
Beattie, R. H	1	Rock removal	C.
Beauvais, A. J	1	Pier work	OO.
Beauvais & Co	1	Breakwater work	OO.
Beckman, C. E	1	Dredging	XX.
Bedinger, L. E	1	Gasoline motor	CC.
Beeman, Geo. W	3	Dredging, removing bowlders, etc.	E.
Beidler & Co., Francis	1	Timber	JJ.
Belanger, Louis	2	Clay	PP.
Belden & Sons, E. S	22	Stone, breakwater; stone, in jetty; stone, and for hire of lighter; stone, breakwater repair; repairing and enlarging breakwater; stone for breakwater extension.	A, C, D, E, F.
Belden, E. S	4	Stone, breakwater; stone, breakwater repair; stone in jetty.	A, C, F.
Bell, J. E	1	Riprap stone	Y.
Belmont Iron Works	1	Steel plate	LL.
Bennett & Co., T. J	3	Pier work	OO.
Bennett Fuel & Ice Co., S. P	16	Coal, fuel	OO.
Bennett, M	1	Clay	PP.
Bennett, Schnorbach & Co	6	Pier work; stone, breakwater work; constructing revetment, sheet pile.	MM, OO.
Bennett, S. P	1	Earthwork	JJ.
Benson, Thos	1	Lease of room	U.
Beauvais. (See MacDonald.)			
Benton & Son, Thos. P	1	Electric-light plant	U.

Contractor.	Approximate number of contracts.	For—	For works in districts—
Berry, F. A	3	Dredging	D.
Berthold & Jennings Lumber Co	1	Oak timber	PP.
Beyworth. (See Christie.)			
Biddle, W. E	1	Dredging	B.
Bigelow, A. G	2	.....do	P.
Bingham. (See Marsh.)			
Bingham, F. J	2	Scow hire	VV.
Blackmer, F. C	1	Dump scows	M.
Blackstaff Engineering Co	2	Jetty work; stone for raising jetty.	O, P.
Blaisdell Machinery Co	1	Installing air compressor	CC.
Blalock & Hartsfield	1	Constructing piers for bridge	M.
Blanton & Co., J. B	2	Sand and gravel	DD.
Blair Steel Centering Co	1	Structural metal and special winches.	X.
Boeckler Lumber Co	1	Timber	JJ.
Boehm. (See Van Sant.)			
Bogie, E. A	1	Constructing dwelling above foundation.	DD.
Bone, F. A	1	Reconstructing ice pier	CC.
Boole & Son, W. A	1	Constructing snag boat	UU.
Bornstein, Jacob	3	Stable and storehouse; 1 gray pressed brick power house; blacksmith shop.	CC.
Boston & Maine R. R	4	Rent of wharf; use of dock and wharf.	B.
Boston & Sons, Chas	3	Hire pile-driver plant; dike repairs; scow construction.	PP.
Botsford, H. S	4	Oil	SS.
Bouker Contracting Co	1	Repairing and enlarging breakwater.	F.
Bowen. (See Tatem.)			
Bowers Hydraulic Dredging Co	2	Dredging	I, K.
Bowers Southern Dredging Co	30	Dredging; removing mattress sill	M, P, R, S, T, U, HH.
Bowles, J. R	1	Steel	WW.
Boyd, W. M	1	Hull for steamer	P.
Brackett Bridge Co., The	1	Steel and iron work for dam	CC.
Brady Construction Co	3	Buildings; building power house	CC, FF.
Bradley Construction Co., The W. B.	1	Jetty work	L.
Breakwater Co., The	20	Stone, breakwater; stone, jetty; stone, dike repair; stone in dike and breakwater; breakwater; breakwater construction; breakwater repair; dike construction; riprap around pier and relaying stone in pier; breakwater work; breakwater construction.	A, B, C, D, H, I, QQ, RR, YY.
Breakwater Construction & Engineering Co.	2	Stone, jetty	B, L.
Breakwater Construction Co., The	1	Jetty work	QQ.
Brehm. (See Kaps.)			
Brewer & Jones	1	Sand and gravel	Q.
Breymann & Bros., G. H	27	Dredging; rock removal; rock excavation; hire of dredging plant.	B, C, PP, QQ.
Breymann Bros	4	Dredging	B, QQ.
Breymann, Geo. H	1	.....do	B.
Briar Bluff Coal & Mining Co	1	Coal	JJ.
Briggs, J. M	6	Dredging	F, G.
Briner, C. J. & F. E	1	Wiring, lamps, etc	HH.
Brooks. (See Sanford.)			
Brooks, S. W. K	1	2 survey scows	B.
Brown. (See Tatnall; Sherman.)			
Brown, Horace	1	Sale and removal of U. S. building.	H.
Brown, Thos. W	1	Bottom-dump lighter	N.
Brubaker, O. G., & A. McKechnie	1	Dike work	PP.
Bryan Black Lumber Co	1	Waling timbers	HH.
Bryant Lumber Co	2	Lumber; white-oak lumber	Y.
Buckeye Contracting Co	5	Jetty work, pier repairs	QQ.
Bucyrus Co., The	7	Pump and engine; machinery for dredge; dredge parts; pump runners; building elevator dredge; machinery.	Q, AA, HH, MM, YY.
Bues, A. F	3	Dredging	MM, OO.
Buffalo Dredging Co	20	Furnishing and operating drill boat; dredging; lock construction; pier construction; breakwater; stone; concrete work, piers; stone work.	PP, QQ, RR.
Builders Sand & Gravel Co	1	Repair of dams and shore protection.	HH.

Contractor.	Approximate number of contracts.	For—	For works in districts—
Bullis, Spencer S	1	Dredging	R.
Bunker Co., G. W	1	Breakwater work	OO.
Burcham & Byrnes Construction & Contracting Co.	1	Stone	WW.
Burdin, J. J	1	Hire of towboat	S.
Burgwyn, C. P. E	1	Dredging	L.
Burk, Smith & Nelson	13	Pier repairs; breakwater work; revetment work; construction of pier; building breakwater; rebuilding super pier.	MM, OO, PP.
Burnham, Williams & Co	1	Locomotives	WW.
Burton & Co., W. O	3	Earth filling, dredging	S.
Burt Portland Cement Co	2	Cement	PP.
Bush Construction Co., Wm. R	1	Stone	HH.
Bussen, Albert	2	.....do	HH.
Bussen, H. W	2	.....do	HH.
Butts, J. F	2	Sand and gravel	DD.
Bury Compressor Co	3	2 air receivers at dams; air compressors, receivers, and accessories, furnishing and installing.	CC.
Byrnes. (See Burcham.)			
Caldwell, Thos. W. & H. B	1	Land for storage	AA.
California Construction Co	1	Breakwater work	SS.
California Reclamation Co	2	Dredging; excavating material and building embankments.	SS, UU.
Callahan. (See Katz.)			
Callahan Bros. & Katz	3	Earthwork	JJ.
Callahan, Jos. J	2	Stone for dike; stone in jetties	B.
Campbell's Creek Coal Co., The	3	Coal	CC.
Canal Quarry Co	2	Stone; breakwater construction	RR.
Canney, Edwin	1	Stone in breakwater	B.
Cantrel Construction Co	1	Constructing lock house	EE.
Cape Ann Granite Co. (See Pigeon Hill.)			
Capitol Lumber & Manufacturing Co	1	Yellow-pine timber	DD.
Carden. (See Ball.)			
Carlin's Sons Co., Thos	4	Derrick irons; ropes; building maneuver boat; maneuvering boats for dams.	CC, EE.
Carlton, F. W	2	Rock excavation	A.
Carpenter Co., F. E	1	Iron fence	PP.
Carroll. (See Lineham.)			
Carstens & Earles (Inc.)	3	Lumber	MM.
Carse, H. E	2	Gasoline launch; hardware	SS.
Carter & Clarke	2	Lumber; piles	K.
Carter Lumber Co., C. J	1	Lumber	Y.
Cary & Co. (Inc.)	2	Coal	Q.
Cary, J. H	1	Levee work	HH.
Cascades Construction Co	1	Dredging	WW.
Cashman, Jas. E	2	Repair to breakwater; sheathing for repair to breakwater.	E.
Cashman, John	1	Repair to breakwater	E.
Cassady, R. B., & W. H. Hanna	1	Guide cribs	EE.
Castalia Portland Cement Co	1	Cement	DD.
Catt, C. E	1	Dredging	R.
Caughren, Winters, Smith & Co	1	Canal construction	WW.
Cayuga Lake Cement Co	1	Cement	DD.
Central Dredging Co	4	Dredging	PP, RR.
Century Fuel Co	19	Coal; fuel	NN, OO.
Champion Iron Co	1	Steel trestles	EE.
Chandler Dock & Bridge Building Co.	1	Hire pile-driver plant	PP.
Charleroi Lumber Co	1	Building	FF.
Charleston Lumber Co	1	Lumber, etc	EE.
Charleston Terminal Co	3	Lease of wharf	N.
Chesapeake Stevedore Co	3	Riprap jetty	K.
Chicago & Great Lakes Dredging & Dock Co.	11	Superstructure work; dredging	NN, OO, PP.
Chicago Bridge & Iron Co	3	Superstructure for highway bridges; bridges.	JJ.
Chicago Engineering & Construction Co.	1	Constructing locks and dams	X.
Chipman. (See Roetzel.)			
Christiana Construction Co	1	Jetty work	I.
Christie & Lowe	4	Constructing jetties, sill, mattress; extending east jetty.	HH.
Christie, Lowe & Beyworth	1	Jetties	O.
Christman, Edw	1	Test borings	HH.
Churchyard, I. R	1	Pier work	QQ.
Cincinnati & Suburban Bell Telephone Co.	1	Telephone service	CC.
Cincinnati Butchers' Supply Co., The.	1	Constructing cold-storage room on snag boat.	CC.

Contractor.	Approximate number of contracts.	For—	For works in districts—
Cincinnati Forging & Smithing Co., The.	1	Iron and steel	DD.
City of Portland	1	Dredge hire	WW.
Clapp, J. M	1	Dike work	XX.
Clark & Henry	1	Dredging	YY.
Clarke. (See Carter.)			
Clark, R. J	1	Timber	PP.
Clark, R. T	1	Earthwork	HH.
Clarke & Co., Chas	13	Stone; dredging; jetty work	S, T, U.
Clarke Co., R. P	2	Piling and lumber	E, K.
Clarke, Jas. G	2	Lumber	Y.
Cleary, John	1	Piles	HH.
Clements. (See Sherman.)			
Clifton Bros	14	Reconstructing revetments, guide walls; repairs at locks; repairing canal embankment; rebuilding guide and guard crib; reconstructing conduit, dam; derrick stone; furnishing and driving guard piles above river wall; reconstructing top of dam.	DD, EE.
Coastwise Dredging Co	14	Dredging	A, C, D, F, L, O P, R.
Colbert, C. B	2	Dredge repair; installing machinery in new dredge.	N.
Cole, C. M	16	Dredging; hire of dredging plant and outfit; removing bowlders.	B, C.
Collins, Benj. F	1	Jetty construction	I.
Collins, T. D	1	Timber	FF.
Colonna, C. J	1	Rebuilding snag boat	L.
Columbia Contracting Co	5	Stone	WW.
Columbia Dredging Co	5	Dredging	C, E, G.
Columbia Engineering Works	2	Engine and pile driving machinery; machinery for dredge.	WW.
Columbia Granite & Dredging Corporation.	1	Stone	K.
Columbia Iron Works	1	Repairs to snag boat	CC.
Columbian Construction Co	1	Pier repairs	OO.
Commercial Wharf Co	1	Rent of wharf	B.
Commonwealth Dredging Co	1	Dredging	B.
Connell. (See Fitz Simons.)			
Conrad. (See Van Note.)			
Consumers Coal Co	2	Coal; berth for dredge	N.
Consumers Oil Co	1	Coal	N.
Continental Engineering & Contracting Co.	1	Concrete lock	AA.
Cooperative Building & Manufacturing Co.	2	2 boat hulls	N.
Coos Bay Home Telephone Co., The	1	Rental of telephone instruments	VV.
Coppes. (See Lockow.)			
Corbaley, W. G	1	Stone	TT.
Corbett. (See Jackson.)			
Corbett, Failing & Robertson (Inc.)	1	Iron and steel	WW.
Cornwell, C. L	1	Sandstone	CC.
Cotton, C. E	1	Paving	TT.
Cowan & Pound	1	Pits and foundations	JJ.
Cox. (See Disken.)			
Coyle & Co., W. G	5	Coal	HH.
Coyle, W. G	1	do	HH.
Craig, A. S., and John Exner	1	Temporary buildings	CC.
Crane & Co., C	1	Timber	EE.
Crane & Co	1	Piping, valves, and fitting	U.
Crawford. (See Newman.)			
Crawford, Robt	1	Recovering roof of cement shed	DD.
Crawley. (See Preslar.)			
Creech Bros	1	Dike work	XX.
Crescent City Machinery & Manufacturing Works.	1	Repairs and alterations to dredge	HH.
Cresson Co., Geo. V	1	Engine for dredge	U.
Creswell, T. B	1	Lease dredging plant	PP.
Crites, S. M	1	Lease of towboat and barge	S.
Crosby. (See Fetter.)			
Crumrine. (See Hackett.)			
Cudahy Packing Co., The	1	Meat	HH.
Cullen, F. J	1	Building work at dam	DD.
Cullen-Friestedt Co	2	Repairs to breakwater and canal wall.	NN, PP.
Cumberland Telephone & Telegraph Co.	2	Rent of telephone	S.
Cumings. (See Morris.)			
Cummings, R. A	2	Rebuilding upper guide wall; building Chanoine dam.	CC.

Contractor.	Approximate number of contracts.	For—	For works in districts—
Cunningham, R. M	1	Lumber	BB.
Cunningham, Wayne	1	Dredging	O.
Currie, Duncan J	1	....do	G.
Curtiss, C. B	1	....do	PP.
Curtis, Wm. A	1	Vegetables	UU.
Cutter Co., D. G	1	Cement	LL.
Dady, Michael J	1	Rock removal and shoals	E.
Dady, T. J	2	Dredging	E.
Dalhoff, H	1	Levee work	Y.
Daly & Hannan	1	Excavating mud and bowlders	C.
Daly & Hannan Dredging Co	12	Dredging; repairing breakwater; rock work.	B, C, E, RR.
Daly, W. J	1	Repair to breakwater	E.
Darrah Bros	1	Buildings	FF.
Darrah, G. B	1	....do	FF.
Darring, Louis, and L. Mouledons	1	Vegetables	HH.
Davidson & Co., Geo. W	1	....do	HH.
Davidson, Jas	3	Dredging	PP.
Davidson, Stephen	3	Frame storehouse; constructing lock keeper's house, etc.	CC, EE.
Davis, C. D	1	Stone and spalls	HH.
Davis, C. E	2	Removing rock and bowlders	C.
Davis, J. H	1	Riprap stone	K.
Davis, R. N	1	Piles	HH.
Dayton & Francis	1	Constructing lock keeper's houses	CC.
De Haas, N. G	3	Timber	PP.
Delmas, Albert C	1	Dumping dredged material from channel.	R.
Denmead Bros	1	Lumber	K.
Dennis, C. A	1	Pier construction	RR.
Des Moines Bridge & Iron Works	3	Steel barge; constructing steel derrick; steel tower; water tank.	CC, DD.
Detroit Dredging Co	3	Dredging	PP, QQ.
Devil's Hollow Stone Co	1	Crushed stone	DD.
De Witt & Shobe	3	Revetment; dike	GG.
Diamond Coal & Coke Co	1	Coal	HH.
Disken & Co., T. W	1	Hire of towboat	DD.
Disken & Cox	1	Stone filling	DD.
Dixie Towing Co	2	Hire of barge and towboat	DD.
Dixon, S. O	36	Dredging	MM, NN, OO, PP.
D'Olier Engineering Co	1	Lock machinery	RR.
Donald & Co., A	1	Stone in place on breakwater	LL.
Dodge. (See Gahren.)			
Donnelly Contracting Co., The	3	Dredging; repairing pier; constructing breakwater.	PP, QQ.
Donnelly, J. B	1	Pier construction	RR.
Donovan, S. J	3	Dredging	A, B.
Donovan, J. F	2	Stone in breakwater	C.
Douglass, H. A	2	Sand, stone	EE.
Doyen Co., P. H	1	Stone, breakwater	A.
Doyen, P. H	3	Dredging; stone, breakwater; stone, jetty.	A, B.
Doyle. (See Dravo.)			
Drackett & Terrebonne	4	Repairs to dredge; dredge	S.
Dravo Contracting Co., The	9	Building foundations, lock keeper's houses; constructing lock and dam; Chanoine dam; locks; buildings; excavation.	CC, FF, HH.
Dravo, Doyle & Co	1	Machinery	FF.
Drews. (See Lydon.)			
Driscol. (See Kirk.)			
Driscoll, A. C	5	Dredging	E, G.
DuBois Bros. Dredging Co	2	Dredging and removing bowlders	E.
DuBois' Sons Co., Henry	1	Dredging	D.
Dubuque Boat & Boiler Works	5	Constructing dredge; snagging plant; towboats; parts of hydraulic dredge.	X, Y, CC, GG, HH.
Duff Patents Co. (Inc.)	1	Tank and tower	CC.
Duffy, J. T	1	Hire of towboat and crew	CC.
Duford. (See Adams.)			
Duke & Smith (Inc.)	1	Lumber	K.
Duluth Dredge & Dock Co	5	Dredging	LL, MM, PP.
Duluth Marine Contracting Co	2	....do	QQ, RR.
Duluth-Superior Dredging Co	4	Dredging; rubble mound breakwater.	LL.
Dunbar. (See McNaughton.)			
Dunbar & Sullivan	1	Removing rock	E.
Dunbar & Sullivan Dredging Co	3	Furnishing and operating drill boat; dredging.	PP.
Dunbar, V. E	1	Hire of scow	PP.
Dunning, Halsey H	1	Culverts	UU.
Durocher. (See Semande.)			

Contractor.	Approximate number of contracts.	For—	For works in districts—
Durocher, Thos. L	14	Building embankment for breakwater extension; breakwater work; derrick boat; dredging; stone.	LL, OO, PP.
Dupuis Co., A. J	3	Revetment repairs; hire piledriver plant.	PP.
Dutro. (See Gregg.)			
Du Vall, F. J	1	Stone for dam	CC.
Du Vall, F. J. & F. C	1	Constructing ice pier	CC.
Earle, W. B	2	Oak timber	PP.
Earles. (See Carstens.)			
Earnheart, R. W	3	Gravel, stone, and timber	Y.
Eastern Dredging Co	21	Rock excavation; stone, jetties; dredging; ledge rock removal.	A, B, C.
East Shore Dredging Co	1	Dredging	OO.
Eaton, Chas. W	1	.....do	J.
Eckley, W. P	1	Building dwelling	DD.
Edison Portland Cement Co., The	2	Cement	CC.
Edward Bros	2	Dredging	PP.
Edwards & Co., Jos	2	Elbows and sleeves; parts for dredge.	HH.
Egan. (See Baker.)			
Egan, Smith & Co	1	Mooring dolphin	O.
Elias & Bro., G	7	Square timber; surfaced timber for dam; lumber.	E, CC, EE, PP.
Elk Cement & Lime Co	3	Cement	PP.
Ellicott Machine Co	21	Rehandling machine; machinery and appliances for hydraulic dredge; revolving cutter, etc., for suction dredge; constructing dredge; suction dredge.	H, N, Q, R, T, CC, HH, LL, SS, UU.
Ellis, Walter	1	Raising and reconstruction	DD.
Ellis, W. H	1	Stone	B.
Elmendorff, Loren H	1	Piling	E.
Elmore & Co., S	1	Coal	WW.
Elwell. (See Mervy.)			
Embrey, W. S	1	Lumber	K.
Empire Engineering Corporation	2	Dredging	RR.
Erskine. (See McDevitt.)			
Eskald & Alexander	2	Stone for lock; lock gates	S.
Eskald, Peter	3	Pile driver and derrick plant; constructing dwelling; dams, sheet-pile construction.	HH.
Eubank, W. A	1	Piles	K.
Evans & Justice	1	Push boat	DD.
Evans Bros. Construction Co	1	Lock houses	AA.
Evansville Contracting Co	10	Constructing lock and abutments, Chanoine dam; lock for dam; building masonry piers and south shore abutment; rebuilding lower guide wall; iron and steel trestles and platforms.	N, CC, DD.
Everson, E. N	1	Constructing lock keeper's houses.	CC.
Exner. (See Craig.)			
Fagan. (See MacDonald.)			
Falling. (See Corbett.)			
Fairbanks Co., The	2	Hoisting engine; machines	HH.
Farney, A. W	1	Dikes	GG.
Favre, Thos. M	3	Wooden pontoons; barge; survey motor boat.	R.
Featherstone Foundry & Machine Co.	3	Dredge machinery; dredge construction.	AA, WW.
Federal Contracting Co., The	2	Stone for breakwater; breakwater construction.	B, QQ.
Fellows Coal Co., E. O	1	Coal	HH.
Ferguson, Hugh	1	.....do	N.
Ferguson, W. B	1	Timber	Y.
Ferrell, A. J	1	Telephone poles	EE.
Ferrill. (See Allbright.)			
Fetter, A. V	3	Construction and repair of dams and shore protection.	HH.
Fetter & Crosby	2	Building dams and shore protections.	HH.
Fiborn Limestone Co	3	Stone	PP.
Field. (See Leek.)			
Finley Bros. Co	2	Temporary building dam; lock master's houses.	CC, EE.
Finney, Clark	1	Dredging	B.
Fisher, C. W	1	Lease of warehouse	T.
Fitch, C. F	1	Concrete pavement	CC.
Fitzpatrick & Son, J. J	1	Dredging	B.

Contractor.	Approximate number of contracts.	For—	For works in districts—
Fitzpatrick, J. J	2	Ledge rock removal; rock excavation.	A, C.
Fitz Simons & Connell Co., The	8	Dredging; concrete superstructure.	LL, NN, OO.
Flagler & Vedder	1	Paving stone	E.
Fleming. (See Rye.)			
Flesher, Benj. T	1	Dump boat; service boat; push boats.	EE.
Flynn Bros	1	Earthwork	JJ.
Foltz & Jonte	1	Constructing lock	DD.
Fonder Co., Edw. F	1	Dredging	I.
Fonder, Edw. F	1	do	I.
Fonts, Milton	3	Timber	DD.
Fordyce Manufacturing Co., Thos	1	Iron and steel	Y.
Fortmer. (See Henningsen.)			
Foundation Co., The	1	Constructing lock and dam	CC.
Francis. (See Dayton.)			
Frankman Bros. & Morris	1	Pile revetment	MM.
Franks, J. C	3	Dredging	TT, UU.
Frederick & Arnold	1	Buildings	WW.
Freeborn, W. J	1	Piles	PP.
Frelinger, J. G	1	Drift bolts	DD.
French, W. H	6	Dredging	K, L.
Frey. (See Hunter.)			
Frick Co	1	Ice plant	CC.
Fridman Lumber Co., The	1	Oak timber for dike	CC.
Friestedt. (See Cullen.)			
Fritsch, Arthur	1	Spud lift, suction frame, and fittings.	U.
Fuller, J. G	1	Repair to log boom	P.
Fuller, W. D	3	Stone, etc	E.
Fullerton, Humphrey	1	Lease of office room	HH.
Gahren, Dodge & Maltby	1	Constructing lock and dam	DD.
Galloway, P. W	2	Breakwater	MM.
G. & W. Manufacturing Co	4	Rods, bolts, etc.; lock gates and operating machinery; constructing highway bridge.	E, K, N, CC.
Garbish. (See Helgason.)			
Gardner Construction Co., J. H	1	Dredge and snag boat hire	S.
Garrettson, W. F	1	Constructing dam	DD.
Gates & Co., G. W	2	Fir timber	PP.
Gatti. (See Krebs.)			
Gaylord, L. T	2	Dredging	U.
Gaylord, N. J	7	Constructing extension pier; pier work.	MM, OO.
Gazzam. (See Bair.)			
Geake & Co., G	1	Constructing wharf and bunkers	XX.
Gee Electric Construction Co	2	Furnishing and installing gas engines.	CC.
General Electric Co	1	Electric plant for U. S. S. Sentinel.	J.
Georgetown Iron Works	1	Installing machinery on snag boat.	N.
Gerrish, J. H	14	Dredging; ledge rock removal	A, B, D, E, G.
Gibson, O. A	1	Levee construction	X.
Gilbert, H. P	1	Rebuilding dikes	K.
Gilbert, J. W	1	Constructing bulkhead	R.
Gillen & Gillen	1	Repairing breakwater	NN.
Gillen Dock, Dredging & Construction Co., The Edw.	2	Breakwater construction	QQ.
Gillen, W. H	4	Constructing superstructure breakwater; pile work.	MM.
Gillespie Co., T. A	9	Constructing lock and guide walls, power house, navigable pass, abutment piers, weirs for dam, lock for movable dam, stone, locks and dams.	CC, FF.
Ginsel Co., John	1	Repairs to piers	PP.
Glazier, W. L	1	Constructing ice pier	CC.
Glencoe Lime & Cement Co	2	Cement	X, Y.
Golden Gate Dredging & Reclamation Co.	1	Dredging	UU.
Golden Gate Dredging Co	1	do	UU.
Goodsell, E. R	1	Fenders and booms	E.
Goodyear, C. P	1	Dredging	O.
Gordon, N. E	1	Hire of plant for bowlder removal.	B.
Grafton Quarry Co	1	Stone	HH.
Graham. (See Vinson.)			
Graham, L. M	1	Lease of land	T.
Graham, O. P	1	Launch	VV.
Grainger & Co	2	Furnishing and delivering steel; steel and iron parts for Chanoine dam.	U, CC.
Grainger, H. G	1	Constructing dike	CC.

Contractor.	Approximate number of contracts.	For—	For works in districts—
Grange, Loodice	2	Rent of dwelling	S.
Grattan Contracting Co	1	Pier construction	RR.
Gratto & Reimers	1	Repairing snag boat	UU.
Graves, O. F	2	Gasoline launch	WW.
Gray. (See Meeds; Welsh.)			
Grays Harbor Construction Co	1	Wharf and trestle construction	XX.
Great Lakes Construction Co	6	Breakwater construction and repairs; concrete work; pier construction; breakwater and pier heads.	QQ, RR.
Great Lakes Dredge & Dock Co	70	Rock excavation, rubble mound breakwater; dipper dredge; riprap; rubblestone covering; dredging; building crib breakwater; timber superstructure; dock construction; pier work; concrete work; constructing approach to lock; repairs to canal wall; stone; bridge construction.	B, LL, MM, NN, OO, PP, QQ, RR.
Great Lakes Towing & Dock Co	1	Dredging	MM.
Green, Adolph	3	Breakwater construction and repairs; pile.	MM, OO.
Green Stone & Quarry Co	3	Stone	MM, OO.
Gregg & Dutro	1	Timber	DD.
Gregg & Co., W. S	2	do	DD.
Gregg, Winfield S	1	Lock gate timber	DD.
Greiling Bros	15	Dredging; building pier and breakwater.	MM, NN, OO.
Greiling Bros. Co	7	Dredging; caissons and removing pier.	MM, OO.
Griffith, J. B	1	Lease of tug	T.
Griffith, McDermott & Watt Co	1	Dredging	NN.
Griffiths Iron Works Co	1	Wrought iron	Y.
Grim, Chas. F	1	Dredging	L.
Grim, Chas. P	7	do	I, K.
Grim, John L	5	do	K, L.
Griscom-Spencer Co	1	Joints for dredge	HH.
Groch & Townsend	1	Dredging	QQ.
Guess, jr., C. M	1	Dredge hire	S.
Gulf City Boiler Works Co	2	Boilers and fixtures for snag boats.	Q.
Gulfport Construction Co	1	Creosoting wooden hull	Q.
Gulfport Creosoting Co	3	Wooden barges; piles, lumber, etc.	Q, HH.
Hackett & Crumrine	1	Hire of tug	PP.
Hackett & Mullen	3	do	PP.
Hackett, G. G. & F. H	3	do	PP.
Haff, W. P. W	1	Coal	F.
Hale & Kern Contracting Co	2	Stone	WW.
Hall, James H	1	Launch construction	XX.
Hall, J. W	2	Launch, snagging	XX.
Hall, jr., F. O	1	Building launch	N.
Hall Steam Pump Co	3	Machinery	FF.
Hamilton, A. C	1	Dredging	UU.
Hamilton & Sawyer	4	do	A.
Hamilton Lumber Co., The	1	Timber for dam	CC.
Hammitt, J. M	2	Constructing quarter boat and towboat.	EE, FF.
Handy, C. M	2	Pier construction; stone	RR.
Hanna. (See Cassady.)			
Hanna, W. H	1	Buildings, fences, etc	EE.
Hannan. (See Daly.)			
Hanson, Alonzo	2	Constructing core wall; concrete pavements.	DD.
Harlan & Hollingsworth Co	2	Machinery, etc., for new hull; steel hull.	N.
Harper, H. T	2	Oil	SS.
Harries & Letteney Co	1	Dredging	B.
Harris. (See Witter.)			
Harris, Edward M	1	do	L.
Harris, J. D	1	do	TT.
Harris, J. W	1	Timber	DD.
Harris, Marshall C	5	Dredging	TT, UU.
Harris, N. R	6	do	TT, UU.
Harris, T. O., estate of	1	Office rent	AA.
Hartford & New York Transportation Co.	13	Dredging; removing sunken piers.	D.
Hartley Boiler Works	2	Steel boilers	Q.
Hartsfield. (See Blalock.)			
Hartweg, Fred	2	Coal; piles	HH.
Hathaway & Co., J. E	2	Driving pile foundation; repairs to south revetment.	MM, OO.
Haubtman & Loeb	1	Engines for dredge	HH.
Hausler & Lutz Towing & Dock Co	2	Rebuilding dock	NN.

Contractor.	Approximate number of contracts.	For—	For works in districts—
Hausler & Lutz Towing Co	1	Breakwater	MM.
Hawaiian Dredging Co	3	Dredging	YY.
Hayward Co., The	1	Dredge bucket	DD.
Hazard, J. I	2	Coal	N.
Healy, Edwin S	1	Cement	Y.
Hearin & Ryan	1	Levee work	HH.
Heffron, Isaac	2	Riprap stone	U.
Hegewald Co., Chas	11	Machinery; trestles for dam; boilers; constructing steam launch; iron work for lock gates.	AA, CC, DD, EE, FF.
Heidenkamp, I	1	Stone	FF.
Heinzelman, Martin	1	Teams	HH.
Helgason Bros. & Garbish	1	Levee work	HH.
Henderson. (See Post.)			
Henhoeffer & Vaughn	1	Repairs, landing piers	H.
Henningsen & Fortiner	1	Dredging	XX.
Henrich, J	1	Breakwater	RR.
Henry. (See Clark.)			
Hess, Eli C	1	Woodwork of house at guard lock	JJ.
Hickler Bros	5	Dredging; reinforcing dike-derrick scow with diver and crew.	PP.
Hickler, H	2	Hire of boats; dredging	PP.
Higgins Oil & Fuel Co	5	Fuel oil	T.
Higgs. (See Hile.)			
Hildreth. (See Johns.)			
Hile & Higgs	3	Building power house	CC.
Hillsboro Dredging Co	10	Dredging; hire of dredging plant	P.
Hinckley, A. R	1	Freightage	RR.
Hingston, E. J	1	Removal of dikes and dredging near dam.	CC.
Hirsch Lumber Co	2	Lumber	E.
Hite & Rafetto	1	Coal	F.
Hoffman, S. W	4	Constructing roadway; conduit at lock; revetment, reconstructing storehouse and waiting room.	DD.
Hoge. (See Mason.)			
Hollerbach & May	2	Repairs to dam; renewal of dam and abutment crib.	BB, DD.
Hollerbach & May Contract Co., The	9	Building lock and dam, dikes; movable dam; constructing guide walls; grading, etc., pass for dam, abutments; piers and weirs; foundation for navigable pass; lock.	BB, CC, DD.
Hollingsworth. (See Harlan.)			
Holmes, J. W	1	Coal	WW
Home Dredging Co	5	Dredging	O, Q, R.
Home Telephone Co., The	2	Constructing telephone line; rental telephone instruments.	CC, WW.
Hope Engineering & Supply Co	1	Installing gas engines and starting air plant.	CC.
Horton, Horace E	1	Hoisting carriages	JJ.
Houlton Lumber Co	1	Piles	HH.
Houston-Rickards Dredging Co	3	Dredging	I.
Howard, E. J	16	Steam tenders; dump scows, hulls; towboat; repairing dredge hull, barges; constructing snag boat; repairing snag boat.	X, Y, AA, BB, CC, DD, HH.
Howard Shipyards Co	4	Building cabin and works of dredge; constructing hull; repairs to floating plant; constructing ice-making and refrigerating plant.	CC, DD.
Hubbard Building & Realty Co	1	Constructing lock and dam	T.
Hubbell & Co., H. W	4	Dredging; hire of boat	PP.
Hugo & Tims	7	Revetment work; timber pile construction; pier work and dredging; piles; superstructure pier.	LL, PP.
Hughes Bros. & Bangs	9	Dredging; stone for ice pier and bulkhead; pier construction.	F, H, QQ, RR.
Hull, Edmund	1	Dredging	PP.
Hunkin Bros. Construction Co., The	2	Superstructure construction; breakwater work.	QQ.
Hunter & Frey	3	Training and building dikes; repairs to revetment.	O, X, Y.
Huthmacher, C. C	2	Stone and spalls	HH.
Icenhower, Geo. W	1	Borings	CC.
Inland Marine Construction Co	1	Boat	FF.
Inland Waterways Co	1	Breakwater work	RR.
Illinois Steel Co	1	Cement	LL.

Contractor.	Approximate number of contracts.	For—	For works in districts—
Independent Asphalt Paving Co. & Northwest Contract Co.	1	Rock	XX.
Independent Bridge Co	6	Lock valves, lock gates; steel work for lock gates; bolts; furnishing and erecting lock gates.	U, AA, CC.
Indian Refining Co	20	Crude and fuel oil	OO.
International Contracting Co	10	Dredging; rock removal	C, D, E, F, G.
International Dredging Co	1	Dike work	XX.
Interstate Lumber Co	1	Lumber	EE.
Ironton Portland Cement Co., The	3	Cement	CC, DD.
Jackson & Corbett Co	1	Pier work	NN.
Jacobs Lumber Co., B. F	1	Building	FF.
Jacobson, John	6	Dredging	T, U.
Jahncke, Ernest Lee	1	Constructing barges	HH.
Jahncke (Inc.), Fritz	1	Cement	S.
Jahncke Navigation & Improvement Co.	4	Dredging	S.
Jahncke Navigation Co	2	Dredging; hire of dredge	S, HH.
Jennings. (See Berthold.)			
Johnson & Anderson	2	Building	FF.
Johnson-Anderson Co	1	Constructing wharf and jetty work	VV.
Johnson & Co., Wm	1	Coal	N.
Johnson & Roach	1	Riprap	OO.
Johnson, E. T	2	Rock excavation; dike repairs	WW.
Johnson, Geo. R	1	Lumber	E.
Johnson Iron Works	8	Constructing survey boat; boiler; repairs to dredge and tug; barge construction; rebuilding boat.	HH.
Johns, S. F., and W. H. Hildreth	1	Rebuilding wheelhouse on snag boat.	CC.
Johnston & Co., T. H	1	Timber	AA.
Johnston & Virden	2	Rock excavation	A, B.
Johnston Co., The Wm. T	1	Material	CC.
Johnston Contracting Co., The	5	Constructing lock keeper's houses, office and wareroom.	CC, EE.
Johnston, Chas. W	1	Rock excavation	B.
Johnston, Thos	1	Hull and cabin	OO.
Johnston, Wm. Wirt	1	Hull	HH.
Joice, J. K	1	Timber	AA.
Jones. (See Brewer; McGuire; Smyth.)			
Jones & Laughlin Steel Co	2	Twisted steel bars	PP.
Jones, Allen	1	Lease of launch	S.
Jonte. (See Foltz.)			
Judson. (See Baker.)			
Jung Co., J. C	1	Coal	HH.
Jung, J. C	1	....do	HH.
Justice. (See Evans.)			
Jutte & Co., C	1	....do	HH.
Jutte, W. C	1	Dredging	FF.
Kahului R. R. Co	1	Breakwater	YY.
Kammerer & Kern	4	Buildings	FF.
Kanawha Dock Co	7	Towing, docking, and repairing boats; repairing dump scows and floating plant; constructing barges; deck flat, fuel flat, hull for crane boat.	CC, DD, EE.
Kanawha Valley Machinery Works	1	Ironwork	EE.
Kape & Brehm	1	Building power house	CC.
Katz. (See Callahan.)			
Katz & Callahan	2	Earthwork	JJ.
Keeler Co., E	1	Boilers	CC.
Keeney, Thos. Y	2	Stone for locks	EE.
Kendall, F. P	1	Hire and lease of dock	WW.
Kendall, J. B	1	Steel	K.
Kennedy Co., D. J	1	Cement	FF.
Kennedy, Eliz. J	1	Rent of office rooms	UU.
Kennedy, J. D	1	Rock	PP.
Kenney Bros	1	Hire of barge	DD.
Kenney Bros. Co	1	....do	DD.
Kentucky & Ohio Transportation Co., The.	3	Sand; gravel; hire of barge	DD.
Kentucky River Poplar Co	1	Hire of towboat	DD.
Keohane, Patrick	3	Breakwater construction	QQ.
Kepler, H. A	2	Driving piles	GG.
Kern. (See Hale; Kammerer.)			
Kern, Daniel	1	Dump cars	XX.
Kiel Bros. Plumbing & Heating Co	1	Pipes	CC.
Kiernan, John	1	Mattress, pile and rock work; jetty work.	VV.
Killebrew & Co., K. H	1	Stone and spalls	HH.
Killebrew & Co., W. L	1	Brush	HH.

Contractor.	Approximate number of contracts.	For—	For works in districts—
King Bridge Co	1	Superstructure of railroad bridge	JJ.
Kingsford Foundry & Machine Works.	5	Scotch boilers; fuel	N, U.
Kingston, E. J	1	Dredging	PP.
Kinney, jr., Jas	4	Drilling well and fitting with air lift; water system.	CC.
Kinsen & Sons, T. W	1	Earthwork	JJ.
Kinsey Co., E. A	1	Planing machine and feed-roll attachment.	DD.
Kirchner, Albert	6	Building and repair of dams and shore protections.	HH.
Kirk. (See Sheridan.)			
Kirk, W. A	1	Hire of dredging plant	CC.
Kirk, Driscol & Co	7	Construction and repair of dikes; dredging.	E, F, G.
Kirkpatrick, J. D., and W. S. Langford.	1	Hire of towboat and crew, quarter boat and barge.	Q.
Knoblock & Shelton	1	Constructing dam	CC.
Kolkmeyer & Co., H. W	1	Levee	GG.
Kosmos Portland Cement Co	3	Cement	DD.
Kotcher, C. W	1	Lumber	PP.
Kratzer & Co., W. N	2	Steel leaves for bear trap; lock gates.	CC, FF.
Krebs, S. E., and T. C. Gatti	1	Wooden pontoons	R.
Kruse & Banks	2	Scow hire	VV.
Krusi, H	1	Dredging	TT.
Lackawanna Steel Co	1	Steel piling	PP.
Lafayette Bridge Co	1	Superstructure of highway bridge.	JJ.
Lake Erie Dredging Co	9	Dredging; hire of dredging plant	PP, RR.
Lake Shore Stone Co	1	Sand and stone	MM.
Lake Superior Contracting & Dredging Co.	5	Dredging; sand and rock	LL, PP.
Lamontagne, J. A	2	Limestone rock; piles	PP.
Landor, E. J	2	Reconstructing abutments and miter sill for guard gates; building lock and dam.	DD.
Lane Bros. & Co	1	Constructing shore protection	L.
Langford. (See Kirkpatrick.)			
Lanterman, F. D	1	Jetty work	SS.
Lassig Bridge & Iron Works	1	Superstructure of railroad bridge	JJ.
Latham, C. H	2	Dredging	C.
Latta & Terry Construction Co	2	Jetty construction; stone, jetty	I.
Laughlin. (See Jones.)			
Lawhorn & Painter	1	Dredge tender hire	VV.
Lawless, T. Cheney	1	Hire of floating plant	S.
Lawrance. (See Aderholt.)			
Lawrence Cement Co., The	2	Cement	CC.
Laydon, Darby	3	Wing dams, and repairs to	UU.
Lea & Smith	1	Dredging and jetty construction	I.
Leake, J. W	1	Rubblestone	DD.
Leathem & Smith Towing & Wrecking Co.	7	Stone	MM, OO.
Leek & Field	2	Dredging	F.
Leeper. (See Whipple.)			
Legare & Rhett	1	Lease of warehouse	N.
Lehigh Portland Cement Co., The	8	Cement; sand and gravel	CC, DD, PP.
Lenning, M. E	2	Piles; lumber	HH.
Leonard. (See Lowrence.)			
Leonard, R. L	1	Constructing levee	Y.
Lester. (See Warren.)			
Letteney. (See Harries.)			
Lewis Dredging Co., L. M	2	Excavation; rock removal and building levees; dredging.	L.
Lewis Investment Co	2	Hire and lease of rooms	WW.
Lewis, L. M	3	Dredging	L.
Lidgerwood Manufacturing Co	1	Engines for snag boat	EE.
Liebke Hardwood Mill & Lumber Co., C. F.	1	Oak lumber	HH.
Lindley & Co	1	Groceries	UU.
Lineham, Carroll & Co	1	Stone	M.
Lingham, John	1	Foundation and masonry of house at guard lock.	JJ.
Littleford Bros	2	Repairs to snag boat	CC.
Locher. (See Smith.)			
Lock City Manufacturing Co	1	Timber	PP.
Lockerbie, George	1	Dredging plant hire	PP.
Lockhart, Herbert	1	Rent of office room	VV.
Lockow, Albert, and John Coppes	1	Lock master's dwelling	MM.
Loeb. (See Hauptman.)			
Lord-Young Engineering Co	1	Breakwater	YY.
Love & Co., R	1	Pier repair	OO.

Contractor.	Approximate number of contracts.	For—	For works in districts—
Love & Son, R	3	Dredging; repairs to revetment; pier work.	OO.
Love, Robt	5	Pier work; bank revetment and pier repair.	OO.
Lowe. (See Christie.)			
Lowrance Bros. & Leonard	1	Constructing levee	Y.
Lund, C. E	1	Constructing mattress work and shore protection.	XX.
Lutes, C. G	1	Buildings	FF.
Lutz. (See Hausler.)			
Lydon & Drews Co., The	13	Dredging; revetment	MM, NN, OO.
Lynam, Peter	1	Stone in breakwater	F.
Lyons Lumber Co	1	Constructing dwellings	DD.
MacArthur Bros	2	Excavation and construction; excavating, building dikes.	PP, RR.
MacArthur Bros. Co	3	Rock and earth excavation; constructing west canal; lock construction.	PP, RR.
MacDonald, A. B., and Geo. F. Fagan	1	Excavation; constructing wall, etc	PP.
MacDonald & Beauvais	2	Pier extension	OO.
Mackey, D. Clinton	3	Dredging	M.
Magnetite Foundry Co	1	Lamp-posts	LL.
Maltby. (See Gahren.)			
Malley, Edw	4	Excavating work; enlarging spillway and building barrier; furnishing and placing earth.	UU.
Manitowoc Dry Dock Co	1	Survey and inspection boat	MM.
Mansfield Engineering Co	1	Building concrete locks	AA.
Marbleized Fibre Co., The	1	Marbleized fiber covering	CC.
Marcus Building Co., The M	1	Building warehouse	CC.
Marine Iron Works	2	Repairs to dredge; steam capstan	WW.
Marion-Osgood Co	1	Purchase of dredge	AA.
Marion Steam Shovel Co., The	2	Dipper dredge	CC, DD.
Maritime Dredging Co	11	Dredging; removing bowlders and ledge rock.	D, E, F.
Marquette Cement Manufacturing Co	1	Cement	JJ.
Marsch, John	2	Earthwork; excavating lock pit	JJ, PP.
Marshall, Wallace	2	Manufacturing and delivery of highway bridges; superstructure for highway bridge.	JJ.
Marsh & Bingham Co	2	White-oak timber; lumber	JJ, NN.
Maryland Dredging & Contracting Co.	82	Dredging	H, J, K, L, M.
Maryland Steel Co	1	Hopper dredge	H.
Mason & Hoge Co	1	Constructing lock and dam	DD.
Massachusetts Contracting Co	1	Breakwater construction	A.
Massey, A. E	1	Stone	HH.
May. (See Hollerbach.)			
Mayrant (See Simons.)			
McAnany, J. S	1	Dredging	TT.
McArthur. (See McCallum.)			
McBryde. (See Palmer.)			
McCain, S. H	1	Buildings	FF.
McCallum & McArthur	1	Building watchman's house	LL.
McCaughey, John J	1	Earthwork	JJ.
McClure Timber Co	2	Timber	CC, FF.
McCoy, C. M	1	Fir timber	PP.
McCord, D. C	1	Constructing lock and dam	T.
McCormick Lumber Co	1	Timber and plank	MM.
McDermott. (See Griffith.)			
McDevitt & Erskine	2	Installing pipe line and furnishing natural gas.	CC.
McDonald, F. L	1	Building breakwater embankment.	LL.
McEldowney, Thos. P	1	Rent of room	UU.
McGee & Co	2	Levee construction; constructing concrete river wall for bear trap sluice.	A, AA.
McGillis & Co., W. A	1	Dredging	QQ.
McGuire & Stanton Contracting Co. and Edw. Jones.	1	Revetment	GG.
McGuire, Hugh	1	Barrier work	UU.
McGuire, J. P	3	Lock gates; furnishing cover plates; valve engines.	BB, CC, PP.
McHarg-Barton Co	1	Dike construction	E.
McIlvaine & Spiegel Boiler & Tank Co., The.	2	Constructing dipper dredge; installing flue boilers.	CC.
McKallip & Co., L. S	1	Cement	CC.
McKay & Runyon	1	Stone	DD.
McKechnie, A. (see Brubaker)	1	Filling and grading	PP.
McKechnie, A. B	1	Clay	PP.

Contractor.	Approximate number of contracts.	For—	For works in districts—
McKim, T. J	1	Repairs and protection to embankment.	CC.
McLean Contracting Co	1	Dredging	L.
McMurry Contracting Co., J. W	1	Revetment	GG.
McNaughton, P. B., and O. E. Dunbar.	1	Earth and rock excavation	PP.
McQuade Co., J. H	2	Dam construction	FF.
McSpirit, John and Joseph	20	Dredging; rock removal	D, E, F, G.
Meade-Gray Lumber Co	1	Lumber	DD.
Meinken, D	1	Constructing 4 lock tenders' dwellings.	CC.
Memphis Machine Works	1	Refrigerating plant	U.
Menz Lumber Co., The	1	Fir lumber	HH.
Merrill-Stevens Co	10	Repairing dredges; piling and stone; constructing pump boats; building combined dredge and snag boat; hire of dredge.	N, O, P.
Merritt-Stevens Engineering Co	1	Dredge bucket	N.
Mervy-Elwell Co	2	Repairing bridges; building highway bridge.	TT, UU.
Metzger, Delbert E	1	Breakwater	YY.
Michigan Bolt & Nut Works	1	Bolts, rods, etc	PP.
Middleton, Robt	1	Construction of quarter boat and pile driver.	Q.
Midland Land & Improvement Co	2	Dredging	G.
Midland Bridge Co	1	Constructing locks	X.
Miles, B. C	1	Rock	WW.
Milholland Co., J. & J. B	13	Steel, valves, etc.; filling valves, anchorages; steel castings; structural steel; iron and steel; machinery.	S, AA, CC, EE, FF.
Millen & Co., Robt	2	Pier repairs	NN, OO.
Miller (See Pihl; Sang; Randerson.)			
Miller, Andrew	1	Piles	K.
Miller, Hawley	4	Dredging	E, G.
Miller, J. D	1	Rock removal	F.
Miller, J. H	2	Dredging	K.
Miller, John	7	....do	K.
Miller Supply Co	1	Telephone supplies	EE.
Miller, W. S	2	Oil and gasoline	SS.
Mills, John L	1	Dredging	J.
Milwaukee Bridge Co	2	Constructing steel drill boat hull and sluice gates.	HH, PP.
Miner, C. A	2	Dredging	I, L.
Miner, E. L	1	....do	K.
Miner Engineering Co	16	....do	K, L, M.
Minneapolis Steel & Machinery Co	4	Iron and steel; rods, clevises, etc	PP.
Missouri Valley Bridge & Iron Co., The.	2	Barges; constructing lock and dam.	CC, GG.
Mitchell. (See Powell.)			
Mitchell & Co	3	Dredging	M.
Mitchell, John	1	Boilers	CC.
Modern Steel Structural Co	1	Sluice gates, manufacture and delivery of aqueduct.	JJ.
Moffatt, Alex	1	Clay	PP.
Mohler Lumber Co	1	White-oak timber	CC.
Molt, A. J	1	Piles	HH.
Monongahela & Western Dredging Co.	7	Removal, dike, and dredging; hire of dredging plant.	CC, FF.
Monongahela River Consolidated Coal & Coke Co.	9	Constructing scows; dump scows; wooden hull gravel barges; hull maneuvering boat; coal.	BB, CC, DD, HH.
Montgomery, Samuel	1	Building barriers	UU.
Moore & Sieber	5	Pile and brush dike; bulkhead repairs and construction; removing jetty; hull for dredge; jetty construction.	U.
Moore, R	3	Dredging	R.
Moreing, Lewis	3	Barrier building; sand and gravel	UU.
Morgantown Cement Building Block Co.	1	Concrete work	FF.
Morrell, G. R	1	Building	FF.
Morris. (See Frankman.)			
Morris & Cumings Dredging Co	13	Dredging	A, B, C, D, E, F, G, O.
Morris Machine Co	1	Pump and engines	U.
Morris Machine Works	1	Dredge machinery	WW.
Morrison Bros	2	Levee work; removing log jam	X, XX.
Morrison Dredging Co	1	Dredging	G.
Morton, A. E	1	Removing cross banks and building embankments.	JJ.

Contractor.	Approximate number of contracts.	For—	For works in districts—
Moscarelli, Jos	1	Building	FF.
Mouledons. (See Darring.)			
Muir-O'Sullivan Dredging & Dock Co.	5	Dredging	PP.
Mullen. (See Hackett.)			
Municipal Engineering & Construction Co.	2	Concrete mixer	EE, PP.
Munse, Anson B	1	Constructing embankment fill	UU.
Murphy. (See Anderson.)			
Murphy, Richard M	6	Willows, stone	HH.
Murray Co	1	Superstructure of pier	PP.
Murrell. (See Shore.)			
Muskegon Dock & Dredging Co	1	Pier work	OO.
Muskingum & Ohio River Transportation Co.	1	Hire of towboat	DD.
Muskingum River Stone Co	1	Stone	DD.
Myers & Son, P. W	4	Dredging	E.
National Contracting Co	2	Dredging; constructing lock and guide walls, power house, dam, abutment; grading and paving.	G, CC.
National Dredging Co	1	Dredging	R.
National Iron & Steel Co	1	Steel	T.
National Mortar Co	1	Cement	K.
Neil, J. M	2	Constructing dwelling; lock houses, repairs, etc.	DD, EE,
Nelson. (See Burk.)			
Nelson, August	1	Dredging	U.
Newbegin Lumber Co	1	Timber	PP.
Newbegin, J. G	5	Timber for dump scows; lumber	DD, MM.
Newburgh Dredging Co	8	Dredging	E, G.
New England Granite Co	1	Stone	B.
New England Telephone & Telegraph Co.	1	Telephone service	B.
Newhall Chain, Forge & Iron Co	1	Chain and clevises	EE.
New Jersey Car Spring & Rubber Co.	2	Suction hose; rubber sleeves	N, SS.
New Jersey Foundry & Machine Co	15	Chain; steel and cast-iron members for lock gates; distilling plant; furnishing and installing lock-operating mechanism, gate engines for dam; feed-water heater; constructing dam, guide wall, steel service bridge; drift-bolts; steelwork; iron for dams; refrigerating plants.	N, U, CC, DD, EE, HH.
New Kensington Lumber Co	1	Building	FF.
New London Marine Iron Works	1	Wooden scow	E.
Newman William, & Robt. Crawford	1	Cement sheds	DD.
New Orleans Coal Co	1	Coal	HH.
New York & Hartford Transportation Co.	1	Dredging	D.
New York Shipbuilding Co	1	Constructing pump casing for dredge.	HH.
Nicolette Lumber Co	1	Timber	EE.
Niemes, Henry	1	Plumbing	CC.
Nina Realty Co	2	Lease of office and storage rooms	HH.
Niver Coal Co., W. K	1	Coal	F.
Norfolk Dredging Co	7	Dredging and removing wreck, old bridge approach, etc.	L.
Norman, H. R	1	Buildings	FF.
North Alabama Construction Co. (See Shippey.)			
North American Dredging Co	12	Dredging; retaining wall; filling, soiling, sodding; excavating.	P, U, SS, TT, UU, XX.
Northern Dredging & Dock Co	8	Dredging	LL.
Northern Dredging Co	1	do	LL.
Northern Electric Co	1	Transformers and oil switch	PP.
Northwest Construction Co	2	Rock	WW.
Northwestern Steam Boiler & Manufacturing Co.	1	Boiler	LL.
Oades, W. H	2	Rebuilding and repairing boats	PP.
O'Brien. (See Rogers.)			
O'Donnell, Michael J	1	Rock removal	B.
Ogden Co., J. E	1	Bolts, spikes, etc	E.
Ogden, J. E	2	Bolts and bars	PP.
Ohio River Contracting Co., The	12	Hire of dredging plant; building Chanoine dam; dredging; constructing Poiree foundations and extension; constructing lock and dam; repairs and protection of bank; hire of barges; removing ledge.	CC, DD, HH.

Contractor.	Approximate number of contracts.	For—	For works in districts—
Oliver, B. P	1	Office rooms	UU.
Oliver, Joseph	1	Rebuilding lock master's house	DD.
Oliver, J. T	1	Stone and spalls	HH.
Oregon Rafting Co	1	Piles	WW.
Oregonia Bridge Co., The	1	Constructing steel highway bridge.	DD.
Organ, C. H	4	Water-front privileges	HH.
O'Rourke & Co., J. M	2	Repairing jetties; sea wall	U.
Osburn, Fred	1	Removing trestle bents	SS.
Osgood. (See Marion.)			
O'Sullivan. (See Muir.)			
Outzen. (See Shippey.)			
Pacific Bridge Co	1	Hire of dredge and scows	WW.
Pacific Reclamation Co	2	Dredging	TT.
Pacific Telephone & Telegraph Co	1	Rental telephone instruments	WW.
Packard & Co., R. G	3	Removing rock; dredging	E, G.
Packard Co., R. G	13	Ledge rock removal; dredging, shoals; clearing areas; removing dumps.	C, E, F.
Packard Dredging Co., J. S	16	Dredging; rock removal	A, B, C, D.
Page & Shnable	8	Foundations and walls for locks and piers; excavating.	JJ, NN.
Painter. (See Lawhorn.)			
Palmer & McBryde	3	Building barrier and inlet wall	UU.
Palmes, Guy V	1	Coal	Q.
Panke, Wm. F	1	Building lock keepers' houses	CC.
Paquet, Joseph	1	Constructing fish ladder	WW.
Parker. (See Schmidt.)			
Parkersburg & Marietta Sand Co	2	Sand and gravel	CC, EE.
Parkersburg Dock Co	3	Docking and repairing boats	CC, DD.
Parkersburg Mill Co., The	3	Timber	CC, EE.
Parkhill, G. W	2	Raising parts of jetties; raising training wall.	O.
Parrish. (See Spence.)			
Parrott, Richard	4	Dredging; jetty work; building shore protection.	E, I, L.
Parrott, Wm	2	Repairing dikes	E.
Patterson, E. A	1	Rubblestone	DD.
Patterson, J. J	1	Lease of land	T.
Pattin Bros. Co., The	1	Iron, steel, etc	EE.
Payment, F. X	1	Constructing boat	PP.
Pearson. (See Taylor.)			
Pelissier, Noah	1	Sand	LL.
Peninsula Bark & Lumber Co	4	Timber; piles	PP.
Penn-Allen Cement Co	1	Cement	DD.
Penn Bridge Co	21	Lock gates; iron and steel; sluice valves; castings and erection of lock gates; horses and irons for Chanoine wickets; reconstructing bear trap gates at dam; dam parts; constructing frame building.	S, T, X, AA, CC, DD, FF, GG, HH, PP.
Pennsylvania Dredging Co	9	Dredging	I.
Perini, Romano V	2	Repairing jetties	A, F.
Perkinson, Frank	1	Dredging	F.
Perry, Frank	2	Hemlock timber	PP.
Perry, R. A	3	Dredging	SS, TT, XX.
Petersburg Iron Works	1	Constructing wooden hull, seagoing suction dredge.	N.
Pfaff & Smith Co	1	Constructing ice pier	EE.
Phillips, H. W	1	Removing ledge rock	B.
Philpot, C. E	1	Brush	Y.
Picton & Co., D. M	2	Jetty work; constructing stone dike.	T, U.
Picton, David M	3	Jetty construction; stonework on jetties.	U.
Picton Island Red Granite Co	1	Stone	RR.
Pigeon Hill Granite Co. (see Rockport).	1	Stone for breakwater	A.
Pihl & Miller	1	Concrete work	FF.
Pioneer Boat & Pattern Co., The	2	Gasoline boat	CC, DD.
Pittsburgh Bridge & Iron Works	1	Lock gates	FF.
Pittsburgh Dredging & Construction Co.	1	Dredging	FF.
Pittsburgh Forge & Iron Co	1	Bolts, rods, etc	PP.
Pittsburgh Industrial Iron Works	2	Iron and steel, pumps, etc	CC, EE.
Pittsburgh Manufacturing Co	1	Bars, rods, etc	CC.
Pittsburgh Screw & Bolt Co	3	Bolts, rods; manufactured steel	CC, PP.
Pittsburgh Steel Construction Co	1	Superstructure of highway bridges.	JJ.
Pittsburgh Trolley & Forge Co	1	Forgings for dam	CC.
Pittsburgh Valve, Foundry & Construction Co.	2	Pipe fittings, pipes, air receivers, etc.	CC.
Pneumatic Caisson Co	2	Constructing lock and dam	CC.

Contractor.	Approximate number of contracts.	For—	For works in districts—
Polhamus, A. A	5	Dredging, stone	SS.
Pomeroy, Warren H.	1	Dredging	TT.
Pope & Sons, Lewis	1	Services of towboat	DD.
Port Huron Shipbuilding Co	1	Steel lock gates	AA.
Portland Iron Works	1	Constructing dredge	VV.
Port of Portland	4	Hire of dredge	WW.
Post & Henderson Co	1	Timber	RR.
Poston, Newton	2	Coal	WW.
Potomac Granite Co	1	Stone	K.
Potomac Sand & Gravel Co	4	Riprap stone	K.
Pouliot. (See Rose.)			
Pound. (See Cowan.)			
Pound Construction Co	1	Earthwork	JJ.
Powell & Mitchell	2	Pier work	LL.
Power. (See Vermilye.)			
Power & Co., D	2	Repairing training wall; constructing wharf.	O.
Pregnall, Samuel	1	Dredge repairs	N.
Pregnall, S. J	1	do	N.
Preslar-Crawley Co., The	2	Drilling test holes at dams	CC.
Preslar Manufacturing Co., C. F	1	Drilling test holes	CC.
Preslar Prospecting & Engineering Co., The.	1	Drilling test holes for dam	CC.
Preston, J. W	1	Repairs to breakwater	LL.
Price, D. P	1	Stone for dam	CC.
Pritchartt & Co., W. H	1	Meats	HH.
Pryor, Jas	3	Dredging	LL.
Puget Sound Bridge & Dredging Co	13	Dredging; removing rock	XX.
Queen City Marine Co	2	Rent of storage room	CC.
Queen City Marine Railway Co., The.	1	Repairing dump scows	CC.
Queen City Supply Co., The	1	Boiler, hoisting engines	EE.
Rabbitt & Sons Co., The M	2	Stone; constructing new channel	PP.
Racine Boat Co	2	Tug	LL.
Rafetto. (See Hite.)			
Ramsey. (See Albright.)			
Ramsey, James	1	Constructing cement sidewalk	DD.
Randerson & Miller	4	Dredging	E.
Randerson, John P	21	Dredging; removing bowlders	C, D, F.
Rasmussen, Chris & Nels	1	Hire of room	VV.
Reaves, N. C	1	Bottom-dump lighter	N.
Rechsteiner Bros	3	Building dwellings	DD.
Reed, T. S	1	Jetty repairs	T.
Rees & Sons Co., J	4	Boilers; machinery	FF.
Rees, T. M	1	Building repair steamer	FF.
Reimers. (See Gratti.)			
Restein & Co., Clement	1	Suction hose	N.
Rhett. (See Legare.)			
Richardson & Ward	1	Stone	H.
Rickards. (See Houston.)			
Rickards Dredging Co	19	Dredging	L.
Rider, A. J	1	do	L.
Riebolt, August, and Joseph Wolter	1	Pile pier	MM.
Riebolt, Wolter & Co	8	Constructing wooden barge, stone barge; stone; dredging.	MM.
Righter, G. W	1	Timber	EE.
Ripley, H. C	1	Jetty construction	U.
Rippley Hardware Co	1	Gasoline boat	EE.
Richer, Geo. S	3	Cement	UU.
Risley Bros. & Co	1	Stone	T.
Ritter Lumber Co., W. M	1	White-oak timber	EE.
River & Harbor Improvement Co	33	Dredging	I, J.
Riverside Bridge Co	2	Anchor beams; steel lock gates	CC, DD.
Riverside Iron Works	3	Cast-steel drags; drag, pipe and patterns; constructing new hull and installing machinery.	N, O.
Roach. (See Johnson.)			
Roberts & Co., Fred C	1	Bridge work	TT.
Robertson. (See Corbett.)			
Robertson Steel & Iron Co., W. F	1	Plates for dredge	CC.
Robinson. (See Smith.)			
Robinson Lumber, Veneer & Box Co.	5	Timber for lock gates; waling timber; piles and lumber.	S, HH.
Rockport and Pigeon Hill Granite Cos.	2	Breakwater	B.
Rockport Granite Co	1	Stone in dike	B.
Rockport Granite Co. and Pigeon Hill Granite Co.	3	Breakwater; rubblestone in jetty; stone.	B.
Rockport, Pigeon Hill, and Cape Ann Granite Cos.	1	Stone	B.
Rodermond, R. B	3	Dredging; removing bowlders	B, G.
Rodgers & Abel	1	Building concrete wall	CC.
Rodgers Sand Co	1	Sand	FF.
Rodgers, W. C	3	Timber	AA.

Contractor.	Approximate number of contracts.	For—	For works in districts—
Roe & Woodrow	1	Lock-gate timbers	DD.
Roetzel & Chipman	1	Repairs to lock and dam	BB.
Rogers & O'Brien	3	Dredging; excavating	G, QQ.
Rogers, Geo. A	1	Removing reefs	E.
Rogers Lumber Co	1	Lumber	HH.
Rooney, W. E	1	Dredging	PP.
Rose, C. S., and F. X. Pouliot	1	Constructing buildings	PP.
Rosedale Foundry & Machine Co	1	Castings for dam	CC.
Rosedale Foundry Co	1	Machinery	FF.
Ross, P. Sanford	44	Dredging; removing stone and ledge rock; constructing and repairing jetties; sand; riprap in breakwater; material in training wall.	D, E, F, G, L, N, O, P.
Ross, R. G	17	Constructing mound on jetty; stone; repair training wall; jetty work; stone for revetment; rock removal; dredging; hire of dredging plant.	N, O, P.
Rowe Bros. Co	2	Stone, jetties, dike extension	A, B.
Runkle & Wright	1	Piles	FF.
Runyon. (See McKay.)			
Russell, W. S	1	Breakwater work	SS.
Russell Wheel & Foundry Co	2	Gates and sluice valves; sluice gates.	JJ, NN.
Rust. (See Swift.)			
Rust, Swift & Co	4	Revetment; repair of dams and shore protection.	GG, HH.
Rutherford, H. S	1	Hire boathouse	I.
Ryan. (See Hearin.)			
Ryan, Geo	1	Flat scows	MM.
Rye & Fleming	1	Clay	PP.
Sabine Transportation Co	1	Lumber	U.
St. Paul Foundry & Machine Co	1	Grated covers and footwalks	HH.
Salmen Brick & Lumber Co	9	Piles; lumber	HH.
Sammons Co., E. A	2	Boiler; ice machinery, refrigerating plant, distilling plant.	HH.
Sanborn, Geo. W	9	Coal	WW.
Sanford & Brooks Co	10	Timber revetment, piers, sluice, etc., and repairing and retaining banks; dredging; jetty construction; dump scows.	H, J, L, M.
San Francisco Bridge Co	8	Stone; dredging; reclamation	SS, TT, UU, YY.
Sang, Alex	3	Pierhead; stone breakwater	LL.
Sang & Miller	1	Rubble mound	LL.
Sang & Preston	1	Damage to breakwater repaired	LL.
Savage Construction Co	1	Pits and foundations	JJ.
Savannah Dredging Co	2	Dredging	N, O.
Savannah Engineering & Construction Co.	1	do	O.
Sawyer. (See Hamilton.)			
Scaife Foundry & Machine Co	2	Wrought-iron and steel horses	CC.
Scales, Joseph	1	Stone	PP.
Schimp, Mary	1	Rent of house	UU.
Schmidt & Parker Packing Co	1	Meats, etc	UU.
Schmidt, Ernst	2	Dredging	MM.
Schnorbach. (See Bennet.)			
Schnorbach & Co., L. E	2	Breakwater construction; pier	OO.
Schoellhorn-Albrecht Machine Co	2	Marine engines; winches	N, HH.
Schroeder Lumber Co., John	1	Fir timber	PP.
Schwartz Foundry Co	1	Repairs to dredge	HH.
Schwarzschild & Sulzberger Co	1	Meats	HH.
Scofield Co	2	Dredging and change in pier plane; constructing piers.	L.
Scott Co., T. A	9	Hire of lighter; removing bowlders and ledge; dredging.	C, D.
Scott, T. A	1	Dredging	C.
Sea Coast Construction Co	3	Stone for breakwater; breakwater construction.	C, D, QQ.
Seattle Bridge Co	1	Dredging	XX.
Seattle Construction & Dry Dock Co.	1	Constructing dredge	VV.
Sederquist, J. W	1	Steel for lock	S.
Seely-Taylor Co	3	Dredging	E. F.
Semande & Durocher	3	Derrick and diving plant; dredge boat.	PP.
Serrel, W. L	1	Timber	JJ.
Shafer, J. Clements	1	Removing dike and jetty	L.
Shawver Co., W. F	1	Tinwork	EE.
Shea, Thos. J	2	Installing oil tank; oil-burning system.	WW.
Shelton. (See Knoblock.)			
Shelton, W. H	4	Pier construction; stone; concrete work.	RR.

Contractor.	Approximate number of contracts.	For—	For works in districts—
Sheppard, P. H	1	Clay	PP.
Sheridan-Kirk Contracting Co	10	Building section of canal; concrete river wall; lock for movable dam; fitting and connecting pipes; hire of snagging plant; constructing lock and dam; removing wreck.	AA, CC, DD.
Sherman, Brown, Clements Co	1	Rods, bolts, etc	E.
Shervan & Sons, Jas	1	Repairs to dredge	HH.
Short, John	7	Repairs and extension of jetty; repairs to brush dams; bank protection; jetty work; constructing dike; renewal of cribs.	S, T, CC, DD.
Shippey & Outzen	1	Excavation work	AA.
Shippey, W. A., and The North Alabama Construction Co.	1	Excavation, canal trunk	AA.
Shnable. (See Page.)			
Shobe, R. O. (see DeWitt)	3	Revetment; dike	GG.
Shore, Robert, and Bennett Murrell	1	Lock houses	EE.
Sickles, E. C	3	Stone, in dike	E.
Sickles, E. S	3	Stone; dike repair and extension	E.
Sigler, Chas	1	Railroad construction	U.
Sieber. (See Moore.)			
Simono, Chas	3	Dredging	PP.
Simons-Mayrant Co	9	Constructing cofferdam dike; dredging; repairing training wall; shore protection; training dikes.	N, O.
Simpson, J. K	1	Tug	WW.
Simpson & Co., J. C	1	Lumber and millwork	JJ.
Skene & Sons, James	1	Constructing dam guide walls	DD.
Sliger Bros	3	Lumber	CC.
Smart, Edwin L	1	Removing rock	E.
Smith. (See Burk; Caughren; Duke; Egan; Lea; Leathem; Pfaff.)			
Smith & Co. (Grant); and Locher	2	Excavation and channel work	PP.
Smith & Robinson	3	Stone, in dike; repairing breakwater; dredging.	B, F, L.
Smith & Son, C. G	7	Riprap jetties; stone	K.
Smith & Sons, Theo	1	Dredge boat	M.
Smith Co., The L. P. & J. A	3	Dredging	QQ.
Smith, J. B	1	Coal	UU.
Smith, John	2	Dredging	OO.
Smith, Leathem D	2	Stone	OO.
Smith, T. H	3	do	MM, OO.
Smith, T. L	1	Lease of room	U.
Smith, Towles & Co	1	Constructing building	DD.
Smoot, L. E	1	Gravel and sand	K.
Smyth & Jones	1	Canal construction	WW.
Snyder, Augustus	5	Constructing dwellings, etc	DD.
Somerville Bros	1	Lumber	MM.
Soo Hardware Co., The	3	Iron and steel; bolts, washers, etc	PP.
Soo Lumber Co., The	4	Timber	PP.
Soper, O. T	1	Rent of land	DD.
Souther, Charles E	2	Dredging	B.
Southern Bell Telephone & Telegraph Co.	2	Telephone service	N.
Southern Dredging Co	5	Dredging and rock removal	P, Q, R.
Southern Sawmill Co	1	Pile and timbers	HH.
Southern States Portland Cement Co.	1	Cement	Q.
South Texas Telephone Co., The	1	Lease of telephone	T.
Southwestern States Portland Cement Co.	1	Cement	T.
Sower Contracting Co	1	Stone	G.
Sowles Lumber Co., The C. W	1	Lumber	DD.
Spear & Sons, F. B	5	Cement; cement sacks	LL, PP.
Speed & Co., J. B	2	Cement	DD.
Spence & Parrish	1	Wooden revetment	T.
Spencer. (See Griscom.)			
Spiegel. (See McIlvaine.)			
Springfield Boiler & Manufacturing Co., The.	4	Constructing pontoons; steel plate suction head; dredge and pipe line construction.	CC, HH.
Springfield Bridge & Iron Co	1	Aqueducts	JJ.
Standard American Dredging Co	6	Dredging; excavating material; building embankments.	SS, UU, YY.
Standard Construction Co	1	Pier construction	NN.
Standard Contracting Co	3	Excavating; dredging	PP, QQ.
Standard Dredging Co	2	Dredging	YY.
Standard Fuel Supply Co	1	Coal	N.
Standard Oil Co	1	Oils	HH.
Standard Underground Cable Co	1	Light and telephone cable	PP.

Contractor.	Approximate number of contracts.	For—	For works in districts—
Stand, J. J	1	Dredging	QQ.
Stanton. (See McGuire.)			
Stearns Salt & Lumber Co., The	1	Hemlock timber	PP.
Stebbings & Wenzell	1	Breakwater construction	NN.
Steels, John R	1	Constructing office building	CC.
Stern Foundry & Machine Co	5	Coal chutes; bolts, washers, etc.; suction pipes for dredge; repairs to dredge.	HH.
Sterrit-Thomas Foundry Co	1	Lock parts	FF.
Stevens. (See Merrill.)			
Stillwell, Joseph	1	Repairing dike	G.
Stoll, John T	1	Rent of office room	UU.
Stone, Chas	1	Pits and foundations	JJ.
Stoner, R. J	1	Piling and brush fascines	XX.
Streater, J. B	1	Removal snags, etc	S.
Strong & Co., C. H	1	Jetty work	QQ.
Sturgeon Bay Stone Co	1	Stone	MM.
Sturgis, H. H	1	Rock excavation	A.
Submarine Contracting Co	1	Ledge removal	B.
Submarine Signal Co	1	Steamer	L.
Suderley & Sons, C. F	2	Timber and piling	E.
Sullivan. (See Dunbar.)			
Sullivan, J. J	1	Stone	RR.
Sullivan, J. H. & D	2	Hire of tug	PP.
Sullivan, J. K	1	Removal of ledge rock	C.
Sullivan, L. S	2	Hire of tug	PP.
Sullivan, M	12	Dredging; hire of tug; dredging plant; drill boat.	PP.
Sulzberger. (See Schwarschild.)			
Sun Pipe Line Co	1	Fuel oil	T.
Sunset Lumber Co	1	Lumber	LL.
Superior Portland Cement Co., The	3	Cement	CC, EE.
Supple, Joseph	8	Constructing snag boat; scows; dredge; barge; tug.	WW.
Sutter, J. L	1	White-oak timber	DD.
Swarbrick, Jas. G	3	Subsistence supplies	HH.
Sweeney, J. W	1	Stone	WW.
Sweeney Shipyard & Foundry Co., M. A.	14	Constructing stern-wheel tugboat; dredge and snag boat; wooden hull steamboat; machinery.	Q, S, U, X, DD, FF, HH.
Swift. (See Rust.)			
Swift & Co	2	Meats	HH.
Swift & Rust	2	Dike	GG.
Swingle & Co., J. A	1	Concrete work	DD.
Tacoma Dredging Co	3	Dredging	SS, XX.
Talarico, Carmine, and Hy. Watson	1	Excavating and depositing material.	PP.
Talbott & Co., H. E	3	Building lock and dam; armored concrete pavement.	DD, FF.
Talbott Co., H. E	2	Constructing lock	X.
Tanner, Lewis	2	Hire of towboat and crew and plant for removing snags.	CC, DD.
Tatem & Bowen	2	Hoisting engines	WW.
Tatnall-Brown Co	6	Jetty work; sheet piling	L.
Taylor. (See Seely.)			
Taylor & Pearson	1	Removing material and ledge rock	E.
Taylor Dredging Co	1	Dredging	D.
Taylor, H. W	1	Stone	WW.
Taylor, V. E	2	Erecting lock keeper's houses	CC, EE.
Taylor, W. H	4	Dredging	D, F, G.
Teasdale, A. B	1	Building dams and shore protections.	HH.
Terrebone. (See Drackett.)			
Terry. (See Latta.)			
Thames Tow Boat Co., The	1	Ledge removal	D.
Thomas. (See Sterrit.)			
Thomas, E. J	1	Lumber	CC.
Thomas, J. C	1	Raising crest of lock and dam	DD.
Thompson Co., H. B	1	Dam construction	T.
Thompson, J. G	1	Piles driven in beach near dike	B.
Thompson, J. W	1	Sand and gravel	S.
Thomson, Thos	1	Repairs to dam	UU.
Tims. (See Hugo.)			
Todd & Sons	1	Building dwellings, outhouses	DD.
Toledo Dredging & Dock Co	2	Dredging	PP.
Toledo Improvement Co	1	do	PP.
Towles. (See Smith.)			
Trigg Co., Wm. R	1	Dredge construction	HH.
Triple-State Electric Co	1	Electric-light plant	EE.
Triumph Electric Co., The	2	Electric-light plant for dredge; refrigerating plant for snag boat.	CC.
Twiggs, A. J	5	Constructing dikes	O.

Contractor.	Approximate number of contracts.	For—	For works in districts—
Tweeden & Co., A. W	1	Dredging	XX.
Tymon Lumber Co	1	Timber	PP.
Underwood, J. C	1	Sidewalks, pavements, etc	U.
Union Foundry & Machine Co	1	Bolts	CC.
Union Machine Co., The	2	Metal work for dump scows; locomotive-type boiler.	DD.
United Kansas Portland Cement Co	2	Cement	X.
United States Dredging & Contracting Co.	2	Dredging	G.
United States Fidelity & Guaranty Co.	3	Construction and repair of dikes; dredging; breakwater construction.	E, G, QQ.
United States Lithograph Co	1	Printing charts	CC.
Universal Portland Cement Co	5	Cement	CC, DD, MM, RR.
Urania Lumber Co	3	Lumber	Y.
Van Note & Conrad	1	Dike construction	I.
Van Sant & Boehm	1	Dredging	I.
Variety Iron & Steel Works Co	1	Anchorages for lock gates	S.
Vaughn. (See Henhoeffer.)			
Vecchione, Lee	1	Stone for raising lock walls	AA.
Vermilye & Power	1	Air tanks for dam	CC.
Vinyard, E. W	1	Piles and timber	HH.
Vinyard, Wilson M	1	Dike work	I.
Vinson & Graham	1	Stone	T.
Virden. (See Johnston.)			
Virginia Portland Cement Co	9	Cement	CC, DD.
Vodel, A. L	1	Dredging	RR.
Vogt Machine Co., Henry	3	Repairs to dredge; pontoon pipe line and fittings; boilers.	U, CC.
Vulcan Iron Works	2	Lock-gate valves and rods; metal work.	EE, JJ.
Vulcan Steam Shovel Co	2	Machinery, etc., for derrick boat and dredge.	AA.
Waite Lumber Co., H. B	2	Lumber	LL, PP.
Wakefield, Robt	6	Removing rock; jetty work; dredging; dike repairs.	TT, VV, WW.
Walker Co., J. J	3	Furnishing and installing air compressors and pipe work; boiler-feed pump.	CC.
Wallis & Co., B	1	Steel trestles	EE.
Ward. (See Richardson.)			
Ward, Chas	1	Building towboat	EE.
Ward, Zeb	1	Riprap stone	X.
Warner, Geo. T	4	Dredging	O.
Warren & Lester	1	Lumber	WW.
Warrington. (See Blackmer.)			
Washington Stone Co	1	Riprap	K.
Waterbury Co	2	Electric cable and wire; telephone and arc cables.	PP.
Watson, Henry	1	Excavating and depositing material.	PP.
Watt. (See Griffith.)			
Waxler, C. O	3	Building dwelling; storehouse; quarter boat.	DD.
Weaning, L. D	11	Structural metal; lock gates, valves, journal bearings; furnishing material and constructing superstructure of movable dam.	X, AA, CC, DD, FF, JJ, PP.
Weimer, E. D	1	Hemlock timber	PP.
Welsh & Grey	1	Timber	E.
Wenzell. (See Stebbings.)			
Western Fuel Co	3	Cement	UU.
Western Electric Co	1	Engines, dynamos, etc	HH.
West Kentucky Coal Co	1	Coal	HH.
Wharton, M. F	1	Constructing dwellings	DD.
Wharton, J. J	2	Buildings	FF.
Wheeler Condensing & Engineering Co.	1	Condenser	U.
Whipple, C. H., and C. D. Leeper	1	Earthwork	HH.
White & Co., J. G	1	Lock work	T.
White, Robt. M	2	Willows	HH.
White Star Lumber Co	1	Fir timber	PP.
Whitney, A. J	1	Building dams and shore protection.	HH.
Whitney Bros	1	Riprap	LL.
Whitney Bros. Co	5	Building pier; revetment; gravel	LL.
Whitney Supply Co	2	Suction pipe for dredge	HH.
Whittlesey Co., Wm	1	Constructing motor launch	A.
Wieland, G. A	2	Pebbles or gravel; placing stone in breakwater.	LL.
Wilkinson, J. A	1	Lease of dredge	M.

Contractor.	Approximate number of contracts.	For—	For works in districts—
Willamette Iron & Steel Works	3	Castings for dredge; constructing steamboat.	VV, WW.
Williams, Matthew C	2	Water-front privileges	HH.
Williams, Rile E. and Frank C	1	Guard cribs	EE.
Williams, T. J	4	Lock keeper's houses; buildings	CC, FF.
Wills Construction Co., F. K	3	Timber bulkhead construction; piles, etc.; wing-dam construction.	H, I.
Wills, Franklin K	1	Jetty work	I.
Wilmington Dredging Co	4	Dredging	I.
Winnsboro Granite Corporation	2	Stone	M.
Winston Bros. Co	2	Earthwork	JJ.
Winters. (See Caughren.)			
Wisconsin Bridge & Iron Co	1	Superstructure of single-track railroad bridge.	JJ.
Wiseman, W. H	2	Lumber and posts	EE.
Witter, W. G	1	Dredging	TT.
Witter, W. G., and Marshall C. Harris	1	do	TT.
Wolter. (See Riebolt.)			
Wolter, Jos	1	do	MM.
Wood Co., W. W	1	Power house	CC.
Woodman, Frank	1	Steel horses for dams	EE.
Woodward, Roland	1	Hire of dredging plant	P.
Woodrow. (See Roe.)			
Woodward, Wight & Co	4	Subsistence supplies; provisions; parts; groceries.	HH.
Worden, F. E	1	Timber and plank	MM.
Wright. (See Runkle.)			
Wright, J. O	1	Barges	HH.
Wright, Perry	2	Service boats	EE.
Yant & Co., N. D	2	Lock gates	FF.
York Bridge Co	1	Steel trestles	EE.
Young. (See Lord.)			
Younker, J. H	1	Piling	LL.
Yuba Consolidated Gold Fields	1	Training-wall construction	UU.
Zenith Dredging Co	10	Dredging	LL, QQ.

SPECIAL SUBJECTS.

REPORTS, CHIEF OF ENGINEERS, U. S. ARMY, 1866-1912.

SECTION 8.—INDEX TO LAWS AFFECTING THE CORPS OF ENGINEERS, U. S. ARMY.

Copies of laws affecting the Corps of Engineers printed as a part of the annual reports of the Chief of Engineers.—Each annual report of the Chief of Engineers since 1873 has contained, for the convenience of those using the reports, copies of the laws passed by Congress which affect the work or operations of the Corps of Engineers, United States Army.

Classification of the laws.—Most of the laws relate to appropriations for public works, such as fortifications, rivers and harbors, roads, canals, etc. A large number of the laws relate to authorization of private construction of bridges, dams, etc., under the supervision of the Chief of Engineers. Other of the laws relate to the general conduct of public affairs, or to the Corps of Engineers as a part of the Army of the United States.

River and harbor laws.—The "Laws of the United States Relating to the Improvement of Rivers and Harbors, Aug. 11, 1790, to Mar. 4, 1913," have been collected by the Chief of Engineers into a set of three volumes, and printed as H. Doc. 1491, 62d Cong., 3d sess.,[1] with a detailed index thereto. It is not necessary, hence, to make a detailed reference to such laws under the above heading. Some of the titles of the general subjects are given below in order to show what subjects come properly under the head of river and harbor laws. (See also pp. 2090 of this index.)

Laws relating to bridge construction, etc.—The laws which authorize the construction of specific bridges, etc., that is, by name, are covered amply in this index under the heading of "Bridges," or "Structures other than bridges." (See pp. 2137 of this index.)

Laws relating to fortifications, public buildings, etc.—These are referred to in this index, in practical detail, in connection with the subjects of "Fortifications," and "Miscellaneous." (See pp. 1793, 2039 of this index.)

Military laws.—These laws, in greater detail than given in the reports of the Chief of Engineers, will be found in the published volumes of the military laws of the United States. See "The Military Laws of the United States, 4th edition. Prepared under the direction of the Hon. Elihu Root, Secretary of War. By Brig. Gen. George B. Davis, Judge Advocate General, United States Army. With Supplement by Lt. Col. John Biddle Porter, Judge Advocate General, United States Army. 1911." Printed as War Dept. Doc. No. 395. Revised and corrected to date of June 1, 1914, under the supervision of Brig. Gen. E. H. Crowder, Judge Advocate General of the Army, in War Dept. Doc. No. 472.

General laws.—Some of the more general laws which have a bearing upon the work of the Corps of Engineers are referred to very briefly below.

A.

Abandonment of improvements.*

Accounts.
- Time extended for examination. (Mar. 2, 1901.)
- Allowances to officers for losses in War with Spain. (Mar. 2, 1903.)
- Unexpended balances to be covered into Treasury, etc. Permanent appropriations must be created by specific terms. (Mar. 4, 1909, sec. 10.)
- Unexpended amounts for river and harbor works not to be covered into Treasury. (June 25, 1909.)
- Falsification, etc., prohibited under penalty. (Mar. 4, 1911.)
- Additional employees authorized to administer oaths to expense accounts. (Aug. 24, 1912, sec. 8.)

Acids in navigable waters.*

Acquisition of land.*

Adjustments for claims.*

Advertisements.*

Aids to navigation.*

Alaska.
- Railroad commission created. (Aug. 24, 1912, sec. 18.)

Allotments.*

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*See H. Doc. 1491, 62d Cong., 3d sess.

[1] Volume III (150 pages) of H. D. 1491 was prepared in the office of the Judge Advocate General, U. S. Army, and it is described in its preface as being "an attempt * * * to classify and annotate the statutory provisions having a general application, regulating the improvement, protection from obstructions to navigation, and the bridging, etc., of the rivers and other navigable waters of the United States."

- **Anchorage grounds.***
- **Anchoring.***
- **Annual appropriations.***
- **Annual estimates.***
- **Annual reports.***
- **Antiquities, American.**
  - Penalty for unauthorized excavations, etc. Historic lands may be set aside by the President. Regulations concerning collections. (June 8, 1906.)
- **Appropriations.***
  - Army War College, etc. (June 30, 1902.) (And see acts for Army, etc.)
  - Expenditures in excess of appropriations forbidden. Voluntary service forbidden. Apportionment of appropriations into monthly allotments to prevent deficiencies. (Mar. 3, 1905, sec. 4.)
  - Acts must declare in specific terms that an appropriation is made, or that a contract may be executed. (June 30, 1906, sec. 9.)
  - Contingent funds, etc. Apportionment of amount to be expended by each office or bureau. (Aug. 23, 1912, sec. 6.)
  - Regular appropriations restricted to fiscal year. Exceptions, rivers and harbors, etc. (Aug. 24, 1912, sec. 7.)
- **Army officers.***
  - Entrymen under homestead laws who have served in Army or Navy of the U. S. during Spanish-American War shall have certain service deducted. (Mar. 1, 1901.)
  - Provisions for General Staff, etc. (Feb. 14, 1903.) (See also Military Laws, etc.)
- **Arrests, offenders against river and harbor laws, etc.***
- **Ashes, depositing in waters, etc.***
- **Attorney General (in connection with river and harbor violations).***
- **Awards.***

B.

- **Badges.** (See **Military Laws.**)
- **Balances.***
- **Barges.***
- **Beacons.***
- **Bering Sea.***
- **Bidders.***
- **Bids.***
- **Binding.***
- **Boards and commissions.***
- **Boats.***
- **Bonds.***
  - Required from all persons making U. S. disbursements, except officers of the U. S. Army. (June 23, 1866, sec. 3; Mar. 2, 1867, sec. 3.)
- **Books.***
- **Brick deposits, navigable waters.***
- **Breakwaters.***
- **Bridges.***
- **Buildings.***
- **Bulkhead lines.***
- **Bulkheads.***
- **Buoys.***

C.

- **Canada, Dominion of.***
- **Canals and waterways.***
- **Causeways.** (See Bridges.)
- **Care and maintenance of rivers and harbors.***
- **Certification, printing.***
- **Channels.***
- **Charges, tonnage.***
- **Charts.***
- **Checks.**
  - Lost cheques may be duplicated. (Mar. 23, 1906; June 19, 1906; Feb. 23, 1909.)
- **Chief of Engineers.*** (See Military Laws, Army Regulations; and Regulations, Engineer Department.)
- **Cinders.***
- **City limits and river and harbor improvements.***
- **Civilian employees.***
- **Civilian engineers.***
- **Civil Service.** (See reports, etc., Civil Service Commission; Regulations, Engineer Department.)
- **Claims for damages, etc.***
  - False claims prohibited, etc., or purchase of claims, etc. (Feb. 25, 1897; May 30, 1908.)
- **Clams.*** (Fishing for, etc.)
- **Collisions of vessels.***
  - Regulations to prevent, etc. (June 7, 1897.)
- **Collection districts, U. S.***
- **Collectors of U. S. customs.***
- **Coals.**
  - To be tested for the U. S. free of charge. (Mar. 4, 1907; May 27, 1908.)
- **Combined works of improvement.***
- **Commerce.***
- **Commercial statistics.***
- **Commissions.*** (See Boards.)
- **Committees, congressional.***
- **Compensation for displacement of tidewater.***
- **Compensation to U. S. employees for injuries.***
- **Compilations.***
- **Completion of projects.***
- **Concurrent resolutions of Congress.***
- **Condemnation proceedings, for land, easements, rights of way, etc.***
- **Congress.***
- **Congresses of Navigation.***
- **Congressional committees.***
- **Congressional documents.***
- **Consolidated works.***
- **Contingencies, appropriations for.***
- **Continuance of works.***
- **Continuing contracts.***
- **Contractors.***
- **Contracts.***
  - Advertisements for; appropriations; awards; bonds; combined; continuing; eight-hour laws; proposals; prosecution; protection; punishment; regulations.
- **Cooperation, local; public works.***
- **Corporate limits, works of improvement.***

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*See H. Doc. 1491, 62d Cong., 3d sess.

Corporations.*
Corps of Engineers. (See also Chief of Engineers.)
  Officers increased, etc. (Apr. 23, 1904, sec. 22; Feb. 27, 1911, sec. 5.)
Court-martial. (See Military Laws.)
Craft, water.*
Creditors.*
Crimes committed on Mississippi River.*
Crimes.*
Customs, collectors of.*

D.

Damages.*
Dams.* (See pp. 2041 and 2249 of this index.)
Datum plane.*
Débris, mining.* (See pp. 1580 and 2041 of this index.)
Decay in works.*
Defacement of public structures.*
Defenses. (See also Fortifications.)
  Injury.—It is a penal offense to injure or destroy harbor defenses or material thereof, or to violate any rule of the War Department for the protection of defenses. Penalty: Fine, imprisonment, or both, at the discretion of the U. S. court. (July 7, 1898.)
  Material.—American material is to be preferred but foreign material, when such is found preferable, may be purchased in limited quantities and shall be admitted free of duty. (Aug. 1, 1894; Mar. 2, 1895; June 6, 1896; Mar. 3, 1897; May 7, 1898; Mar. 3, 1899; May 25, 1900.)
Department of War.*
Deposits in navigable waters.*
Depths.*
Derelicts.* (See Wrecks.)
Destruction of public structures by private parties.*
Deterioration in works.*
Digging for gold.*
Dikes.*
Dirt, deposits of.*
Disbursement of funds.*
Disbursements.
  No disbursing officer in the Army shall receive commissions or compensation for disbursements made. (June 23, 1866, sec. 3; Mar. 2 1867, sec. 3.)
  Bonds required from all persons making disbursements, except officers in the Regular Army. (June 23, 1866, sec. 3; Mar. 2, 1867 sec. 3.)
  Frequent inquiries to be made by officers of the inspection department of the Army as to the necessity, economy, and propriety of all disbursements by disbursing officers of the Army, and their conformity to the law appropriating the money, and also to the law relating to the manner of keeping accounts and making disbursements. (Apr. 20, 1874.)
Disbursing officers.*
  Substitutes authorized. (Mar. 4, 1909, sec. 8.)
Discharge measurements.*
Discontinuance of improvements.*
Displacement of tidewater.*
District attorneys, U. S.*
District engineers.*
District of Columbia. (See p. 2039 of this index.)
Districts, collection.*
Ditches, mining.*
Dock lines.*
Docks and ferries.*
Documenting of foreign-built dredges.*
Documents, public.*
Dolphins.* (See p. 2249 of this index.)
Dominion of Canada.*
Donations of land, etc.*
Draftsmen, skilled; employment of.*
Drawbridges. (See p. 2137 of this index.)
Drawings.*
Dredge boats.* (See p. 3337 of this index.)
Dues, tonnage.*
Dumpings.*
Duties, tonnage.*

E.

Easements.*
Edgings, deposit of.*
Eight-hour law.*
Emergency appropriations.*
Employees.*
  Additional clerks and other employees necessary during Spanish-American War transferred to classified service. (Apr. 28, 1902 sec. 3.)
  Extortion prohibited. (June 28, 1906.)
  Compensation for injuries, etc. (May 30 1908; Mar. 11, 1912.)
  Attendance at conventions permitted under conditions, etc. (Aug. 24, 1912, sec. 10.)
  Eight-hour law. Public contracts to provide for. Inspectors to report violations. (June 19, 1912.)
  Punishment for violating law requiring specific appropriations for etc. (Aug. 23, 1912, sec. 5.)
  Incapacited employees.—It is unlawful to establish, under appropriations for the executive, legislative, and judicial departments, a civil pension roll or an honorable service roll. or to exempt officers, clerks, or persons in the public service from existing laws concerning public employment. Annual leaves of absence of 30 days, exclusive of Sundays and legal holidays, however, may be granted. (Feb. 24, 1899; Mar. 3, 1901.)
Employment.*
Enforcement of laws, navigable waters.*
Engineer officers.* (See p. 2303 of this index and see Chief of Engineers above.)
Engineers, assistant.*
Engineers, boards of.*
Engineers, Chief of.*
Engineers, civil.*
Engineers, civilian.*
Engineers, Corps of.*
  Composition of, reorganization of U. S. Army. (Feb. 2, 1901, sec. 11.)
Engineer School, Washington, D. C.* (See p. 2039 of this index.)
Engravings.*
Entry, ports of.*

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* See H. Doc. 1491, 62d Cong., 3d sess.

Equipment, motor boats, etc.*
Estimate of funds required.*
Estimates.
    To be submitted exactly as required by law. (Aug. 23, 1912, sec. 9.)
    Lump-sum appropriations exceeding $250,000 to be accompanied by detailed statements of proposed use, etc. (Aug. 24, 1912, sec. 6.)
Examinations and surveys.* (See p. 22 of this index.)
Excavations in navigable waters.*
Executive documents.*
Expenditures, fiscal.*
Expenses.*
Experimental towboats.*
Explosives.
    Detailed provisions for promoting safe transportation of. (May 30, 1908.)

F.

Fillings.*
Filth.*
Fines.*
Fiscal-year appropriations.*
Fisheries.*
Fishing or dredging in navigable waters.*
Fishways.*
Floating of logs, etc.*
Flood reservoirs.*
Flumes, mining.*
Fog signals.*
Foreign-built dredges.*
Foreign (insular) possessions.*
Forest reserves, etc.*
Forests.
    Transfer of reserves from Interior Department to Department of Agriculture. Water rights for mining. Regulations. (Feb. 1, 1905, sec. 4.)
Fortifications.* (See also Defenses.) (See p. 1793 of this index.)
    Fortifications may be erected in cases of emergency upon the written consent of the owner of the land upon which such work is to be placed temporarily. (Joint resolution approved Apr. 11, 1898.)
Freight statistics.*
Funds, surplus.*

G.

Garbage.*
Gauging.*
Gold mining.*
Government employees.*
Government funds.*
Government property.*
Gravel.*
Great Britain.*
Guaranties.*

H.

Harbor lines.* (See p. 2253 of this index.)
Harbors and rivers.* (See pp. 3 and 2041 of this index.)
Hiring of labor.*
Hire of private dredging plant.*
Hiring public property.*
Holidays. (See Regulations, Engineer Dept.)
    Labor Day, the first Monday in September of each year, made a public holiday. (June 28, 1894.)
House of Representatives.*
Hyacinths.* (See p. 572 of this index.)
Hydraulics.*
Hydrology.*

I.

Improvements.*
Illustrations.*
Impaired works, restoration.*
Imperial Valley, Cal.*
Imposts on tonnage of shipping.*
Imprisonment.*
Improvements, river and harbor.*
    Private parties may make improvements at own expenses, etc., subject to approval of Secretary of War and Chief of Engineers. (June 13, 1902, sec. 1.)
Indefinite appropriations.*
Indemnities.*
Index, Reports, Chief of Engineers.
    "Raymond" Index called for. (June 13, 1902, sec. 13.)
    Ordered brought up to date. (July 25, 1912, sec. 6.)
Indexes.*
Individuals, private.*
Injury to Government employees.*
Injury to public structures.*
Inland Waterways Commission.*
Inlets within shore lines, etc.*
Inner harbors.*
Inspectors.*
Insular possessions.*
Internal Improvement, Board of.*
International commissions.*
International Joint Commission.*
International Waterways Commission.*
Interoceanic canals.* (See p. 2357 of this index.)
Intracoastal waterways.*
Island (foreign) possessions.*
Isthmian Canal.* (See p. 2357 of this index.)

J.

Jetties.*
Jurisdiction, crimes, Mississippi River.*
Justice, Department of.*

K.

Klamath Indian Reservation.*

L.

Labor.* (See Public works.)
    Eight hours shall constitute a day's work for all laborers, workmen, and mechanics employed by or on behalf of the U. S. (June 25, 1868.)
    Limited to eight hours in any one calendar day for all laborers or mechanics employed by the Government, or by any contractor upon any public work of the U. S. (Aug. 1, 1892.)

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*See H. Doc. 1491, 62d Cong., 3d sess.

- **Ladders, fish.***
- **Land.***
- **Land, deeds to.**
  - Deeds to land in District of Columbia and Territories may be acknowledged before notaries of Philippines and Porto Rico. (Mar. 22, 1902.)
- **Lands, public.**
  - Former grants to railroads canceled, with some exceptions, etc. (Feb. 25, 1909.)
- **Laws of Congress.***
- **Leases.***
- **Legal proceedings.***
  - Department of Justice shall conduct, where necessary to enforce laws for protection of public property, works, etc. (Mar. 3, 1899, sec. 17.)
  - The U. S. Attorney General or special counsel, etc., may conduct legal proceedings. (June 30, 1906.)
- **Legislation.***
- **Levees.***
- **Levels, water.***
- **Levying of tonnage duties.***
- **Liabilities of contractors.***
- **Licenses, revocable.***
- **Life, human; saving.***
- **Life-saving stations.***
- **Lighters.***
- **Lighthouse Board.***
- **Lighthouses.***
- **Lighthouse districts.***
- **Lights.***
- **Lime, depositing of.***
- **Locks.***
- **Logs, running.***
- **Lots of land.***

M.

- **Mail.**
  - Record of, to be kept. Limitation of penalty privilege. (June 26, 1906.)
- **Maintenance of rivers and harbors.***
- **Marine commerce.***
- **Materials and plant.***
- **Mean low water.***
- **Mechanics, eight-hour law.***
- **Metals, precious.***
- **Mileage.** (See Officers.)
  - Allowances to officers. (Mar. 2, 1901; June 12, 1906.)
- **Militia.**
  - Defined. (Jan. 21, 1903.)
- **Mining.***
- **Moneys.***
- **Motor boats.***
- **Movement of vessels.***
- **Mud.***
- **Municipal corporations.***
- **Municipal limits.***

N.

- **National defense.**
  - Penalties for disclosures. (Mar. 3, 1911.)
- **National Waterways Commission.***
- **Naval officers, retired.***
- **Navigable waters.***
  - Compilation of existing laws enacted from time to time by Congress for the maintenance, protection, and preservation of the navigable waters of the U. S., and draft of an act embodying such revision and enlargement of the aforesaid laws as the experience of the Corps of Engineers has shown to be advantageous to the public interest. (Annual reports of the Chief of Engineers, 1897, p. 4138.)
  - Bridges injuring channels or banks of rivers.
  - Removal of wrecks.
  - Bridges obstructing navigation.
  - Construction of piers, bridges, etc.
  - Depositing material in navigable waters.
  - Unlawful obstructions forbidden and penalties prescribed.
  - Method of enforcing laws forbidding obstructions to navigation.
  - Injuries to Government piers, etc.
  - Harbor lines.
  - Opening of drawbridges.
  - Regulations for canals.
  - The term "navigable waters" (Alaska) held to include all tidal waters up to the line of ordinary high tide, and all nontidal waters navigable in fact up to the line of ordinary high-water mark. (May 14, 1898.)
  - Public vessels may be detailed to provide for safety of life during regattas, etc. (Apr. 28, 1908.)
  - Bureau of Lighthouses in the Department of Commerce and Labor established. (June 17, 1910.)
  - Enforcement of rules. (June 13, 1902, sec. 6.)
  - Creation of any obstruction not affirmatively authorized by Congress prohibited. (Mar. 3, 1899, sec. 10.)
- **Navigation.***
- **Nicaraguan canal route.** (See p. 2357 of this index.)
- **Nonnavigable waterways.***
- **Nontidal waters.***
- **Notices to alter bridges.*** See p. 2137 of this index.)

O.

- **Obstructions.** (See Navigable waters.)
- **Obstructions in navigable waters.*** (See pp. 21, 2137 of this index.)
- **Occupancy of public structures.***
- **Occupancy of public works.**
  - Temporary use of certain public works may be permitted. (Mar. 3, 1899, sec. 14.)
- **Ocean steamships.***
- **Offenders against laws for protection of navigable waters, etc.***
- **Office of the Chief of Engineers.*** (See Chief of Engineers above, and p. 2039 of this index.)
- **Officers.**
  - Detail to instruction schools. (Feb. 26, 1901.) (See Mileage.)
  - Mileage and transportation; leaves; sea travel, etc. (Mar. 2, 1901.)

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*See H. Doc. 1491, 62d Cong., 3d sess.

Officers of the Army and Navy.* (See Military Laws of the United States.)
Officers of the Corps of Engineers.* (See Corps of Engineers above.)
Oysters.*

P.

Pamphlets.*
Panama.* (See p. 2357 of this index.)
Parcels of land.*
Parties, private.*
Pay, extra.
  Instructor, military engineering. (Mar. 2, 1901.)
  Officer in charge of public buildings and grounds, D. C. (Mar. 2, 1901.)
Payments.*
Penal laws.*
Penalties.*
Percentage and reimbursement basis of payment.*
Permanent appropriations.*
Permanent International Congresses of Navigation.*
Permits.*
Personal services.*
Persons, private.*
Philippines.
  Bonds and funds for public works. (Feb. 6, 1905.)
  Providing for administration, etc. (July 1, 1902.)
Photographs.*
Pierhead lines.*
Piers.*
Pipes, mining.*
Planes of reference.*
Plans.*
Plant.* (See p. 2337 of this index.)
Ports of entry.*
Precious metals, mining.*
Preservation and repairs.* (See p. 1797 of this index.)
Printing.*
  Duplicating and filing devices to be transferred to Public Printer. (June 28, 1902, sec. 1.)
  Illustrations. Special act required. (Mar. 3, 1903; Mar. 3, 1905, sec. 1.)
  Cost of preparing documents chargeable to department originating matter; remainder of cost to be distributed. (Mar. 30, 1906.)
  Documents to be printed in two or more editions to avoid unnecessary printing, etc. (Mar. 30, 1906.)
  Estimates for documents required by departments to be submitted. (June 30, 1906, sec. 2.)
  Printing of reports on examinations and surveys authorized, as congressional documents. (June 30, 1906; Aug. 5, 1909.)
  Documents submitted in response to inquiries of Congress to be submitted with estimate of the probable cost of printing. (Mar. 1, 1907.)
Private persons.*
Proceedings, legal.*
Proceeds from various sources, etc.*
Process, swearing out, etc.*
Projects.* (See p. 22 of this index.)
  If amount provided for completion of any project under continuing contract be less than the cost as estimated, proposals for bids shall be invited without further action by Congress. (Mar. 3, 1899, sec. 21.)
Property.*
Property returns.
  Only certificates of loss are to be forwarded to the Treasury accounting officers, and the effect of such certificate shall be the same as if the facts set forth therein had been ascertained by the Treasury officials when accounting. The manner of making returns to the bureau or department concerned not affected by this act, except as provided above. The officer or agent shall, however, have an opportunity to relieve himself from liability. (Mar. 29, 1894.)
Proposals.*
Prosecutions.*
Prosecution of work.*
Protection of waters, etc.*
Protection of persons furnishing labor and materials.*
Protection of lands, etc.*
Publications.*
  All work connected with distribution of publications to be done by the Public Printer. (See Printing above.) (Aug. 23, 1912, sec. 8.)
Public lands and buildings.
  Reservations in Porto Rico authorized. (July 1, 1902.)
Public moneys. (See also Disbursements.)
  Shall not be expended on any site or land for public works hereafter until the validity of the title thereto is established and the consent of the State legislature given to the purchase. Attorney General to examine titles to all lands or sites purchased by the U. S. (Sept. 11, 1841.)
Public property.*
  Proceeds from, to be reported. (June 30, 1906, sec. 5.)
Public works.* (See also Repairs.)
  Labor on, limited to eight hours per day for laborers, mechanics, and workmen. (June 25, 1868; Aug. 1, 1892.)
  Material required for construction of public works and found on bars and islands, or adjacent to said works, may be taken under certain provisions. (July 5, 1884, sec. 6; Apr. 24, 1888.)
  No public work to be deemed as entered upon until appropriations therefor shall have been actually made by Congress. (Aug. 11, 1888, sec. 14; Sept. 19, 1890, sec. 18.)
  Title to land for public works to be established before any moneys are expended thereon. (Sept. 11, 1841.)

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* See H. Doc. 1491, 62d Cong., 3d sess.

Payment for material and labor for.—Contractors on public works shall furnish penal bond to include security for labor and materials purchased. Action may be brought by the owner of such labor or materials, on this bond against the contractor, after fully setting forth the facts in the case to the department. The U. S. shall be at no expense. Security for costs in case of judgment for the defendant shall be required by the court. (Aug. 13, 1894.)

Public works, injury of.
Certain U. S. employees have power of arresting violators. (Mar. 3, 1899, sec. 17.)

Punishments.*

Purchases.*

Q.

Quarantine anchorages.*

Quarantine service.*

Quarantine stations.
Control vested in Secretary of Treasury. (June 19, 1906.)

R.

Radio communication.*

Rafts.*

Railroads.*

Reappropriations.*

Receipts.*

Reference planes.*

Refuse matter.*

Registration.*

Regulations and rules.*

Renting of public property.*

Repairs, preservation, etc.*

Repeal of laws, etc.*

Reports.* (See also pp. 1-22 of this index.)
No supplemental reports shall be rendered to Congress unless authorized. (June 13, 1902, sec. 2.)

Representatives, House of.*

Reservations, forest.*

Reservoirs.*

Resolutions, congressional.*

Restoration, repairs, etc.*

Retired officers of the Army and Navy.*

Revenue, amount collected, etc.*

Revenue officers.*

Revocable licenses.*

Rights of way.*

Rivers and harbors.*

Rivers and harbors, restoration of.
Allotments from emergency appropriation must be recommended by local engineer and the Chief of Engineers. $10,000 maximum. Advertising for bids may be dispensed with. (June 13, 1902, sec. 1.)

Roads.
Provisions for construction of, Alaska. (May 14, 1906, sec. 2; Jan. 27, 1905.)

Rocks, depositing in waters, etc.*

Routes, transportation.*

Rubbish deposits.*

Running of logs, etc.*

S.

Sack rafts, etc.*

Salaries.
Annual compensation to be divided into 12 equal installments. (Apr. 28, 1904, sec. 4; June 30, 1906, sec. 6.)

Sales.*

Sawdust deposits.*

Seaboard transportation routes.*

Sea walls. (See p. 1797 of this index.)

Secretary of War.*

Security.*

Senate, United States.*

Service, voluntary.*

Shellfish*.

Shipping, levying tolls.*

Ships.*

Shore lines.*

Signals.*

Sites.* (See p. 1797 of this index.)

Slab deposits.*

Slack-water systems.*

Slag deposits.*

Slate deposits.*

Sludge deposits.*

Sluiceways.*

Specific appropriations.*

Speed of vessels.*

Statistics, commercial.*

Statutes.*

Stone.*

Storage reservoirs.*

Streams.*

Structures.*

Sunken craft.*

Sunken rocks.*

Supervision of New York Harbor.* (See p. 2111 of this index.)

Supplemental reports.*

Supplies.*

Sureties.*

Surface levels.*

Surplus funds.*

Surveys.* (See pp. 22, 2040, 2041 of this index.)
To locate natural oyster beds, etc., in waters of Maryland. (May 26, 1906.)

Survey marks.*

Suspension (abandonment) of improvements.*

Swearing out of processes, etc.*

T.

Taxation.
Repeal of war-revenue taxation of 1898, 1901. (Apr. 12, 1902.)

Taxes, tonnage.*

Telegraph act.*

Telephone, telegraph wire, etc.*

Telephones.
No expenditure for, in private residences. (Aug. 23, 1912, sec. 7.)

Terminal and transfer privileges.*

Tidal waters.*

Timber running.*

Tolls, levying.*

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* See H. Doc. 1491, 62d Cong., 3d sess.

Tonnage.*
Towboats.*
Towing.*
Transfer and terminal facilities.*
Transfer of land, etc.*
Transportation of refuse matter.*
Transportation routes to seaboard.*
Trespasses.*
Tributaries.*
Tunnels.*
Tying-up of vessels.*

U.

Unexpended balances.*
United States officers. (See also Employees.)
No disbursing officer in the Army shall receive commissions or compensation for disbursements made. (June 23, 1866, sec. 3; Mar. 2, 1867, sec. 3.)
Unlawful obstructions.*
Unnavigable waters.*
Unserviceable land.*
Unworthy works.*
Useless lands.*
Use of public structures.*

V.

Vessels.*
Procedures governing placing of liens. (June 23, 1910.)
Violations of law.*
Voluntary service.*

W.

War Department.*
Warehouses.*
War, Secretary of.*
Waste matter.*
Water depths.*
Water hyacinths.*
Water level.*
Water power.*
Water-reserve lands.*
Waters, navigable.*
Waters, nonnavigable.*
Waterways.*
Weirs.*
Wharves.*
Wireless.
Required on ocean or Great Lakes vessels. (July 23, 1912.)
Wireless communications.*
Works, public.
List of crimes against the operations of the Government, or official duties, public justice, commerce, navigation, etc. (Mar. 4, 1909.)
Worn-out property.*
Worthless property.*
Wrecks.* (See p. 2116 of this index.)
*See H. Doc. 1491, 62d Cong., 3d sess.
*See H. Doc. 1491, 62d Cong., 3d sess.
*See H. Doc. 1491, 62d Cong., 3d sess.
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*See H. Doc. 1491, 62d Cong., 3d sess.
*See H. Doc. 1491, 62d Cong., 3d sess.

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* See H. Doc. 1491, 62d Cong., 3d sess.

SPECIAL SUBJECTS.

REPORTS, CHIEF OF ENGINEERS, U. S. ARMY, 1866-1912.

SECTION 9.—CLASSIFIED AND ALPHABETICAL LISTS OF THE FLOATING PLANT OF THE U. S. ENGINEER DEPARTMENT.[1]

NOTE.—The floating plant or equipment operating under the direction of the Chief of Engineers, U. S. Army, ranges in character from seagoing suction dredges to fleets of rowboats. (See p. 2115 of this Index.)

The following is a summary of the more important tables of the floating equipment, each table of craft-names being arranged alphabetically.

For a complete list of the floating plant, see **10, 2514**; **11, 2801**; **12, 2902**.

TABLE 1.—SEAGOING HOPPER DREDGES.

Name, number, or letter.	Displacement.	Dimensions.			Material.	Complement.		District.
		Length.	Breadth.	Depth.		Officers.	Men.	
	Tons.	*Ft. in.*	*Ft. in.*	*Ft. in.*				
Atlantic	2,670	288 0	47 6	25 0	Steel	9	61	Wilmington, N. C.
Benyaurd	2,978	271 6	47 6	23 0	...do	10	53	New Orleans.
Burton	1,510	177 0	38 0	19 0	...do	5	23	Cleveland.
Cape Fear	480	131 3	29 0	12 0	Wood	4	26	Wilmington, N. C.
Caucus	1,980	200 0	41 0	23 2	...do	7	28	Montgomery.
Charleston	800	122 6	30 0	12 0	...do	6	21	Mobile.
Chinook	7,000	460 0	49 0	34 0	Steel	8	39	Portland, Oreg. (2d).
Clatsop	1,360	180 0	38 0	23 0	...do	8	36	Do.
Cumberland	1,905	200 0	40 8	20 6	...do	6	29	Savannah.
Delaware	4,200	315 0	52 0	22 6	...do	9	50	Philadelphia.
Galveston	3,375	304 0	51 0	27 0	...do	6	26	Galveston.
Gedney	1,500	157 0	36 6	16 0	Wood	4	19	Newport.
Key West	1,000	142 0	31 7	15 0	...do	4	22	Jacksonville.
Manhattan	4,000	288 0	47 6	25 0	Steel	9	48	Philadelphia.
Meade, Gen. G. G	1,458	177 0	38 0	19 0	...do	6	30	Grand Rapids.
Michie, Col. P. S	1,526	242 0	43 0	20 0	...do	6	23	Portland, Oreg. (1st).
Navesink	3,150	290 0	47 6	28 0	...do	9	54	New York (2d).
New Orleans	4,425	315 0	50 0	26 0	...do	14	59	New Orleans.
Raritan	2,930	290 0	47 6	28 0	...do	9	62	New York (2d).
Sabine	700	145 0	35 0	12 0	Wood	5	12	Dallas.
Savannah	1,461	177 0	38 0	19 0	Steel	6	28	Savannah.
Sumter	1,706	200 0	41 0	22 0	Wood	6	34	Charleston.
Winyah Bay	831	141 0	31 6	13 6	...do	4	20	Do.

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[1] In order to have a list including the plant under construction in 1912, the list printed above is of the plant as it existed early in 1913, giving a list for comparison with reports on the floating plant subsequent to 1912.

TABLE 2.—HYDRAULIC PIPE-LINE DREDGES.

Name, number, or letter.	Displacement.	Dimensions.						Material.	Complement.		District.
		Length.		Breadth.		Depth.			Officers.	Men.	
	Tons.	*Ft.*	*in.*	*Ft.*	*in.*	*Ft.*	*in.*				
Augusta	101	74	0	28	0	4	6	Steel		9	Savannah.
Apo	294	132	0	25	5	5	0	Wood, steel, and concrete.	5	13	Rock Island.
Bacon, Henry	1,410	150	6	39	0	15	0	Wood	2	46	Wilmington, N. C.
Barnard	1,291	206	2	38	0	14	0	Steel			Jacksonville.
Beta	1,300	214	0	58	0	6	11	...do	3	42	St. Louis (M. R. C.).
Blackwater	465	110	0	32	0	9	4	Wood	4	24	Montgomery.
Cataract	886	140	6	40	4	10	7	...do	3	23	Philadelphia.
De Witt Clinton	400	95	0	27	6	8	6	...do	8	32	New York (1st).
Congaree [1]	250	101	10	32	0	6	0		2	13	Charleston, S. C.
Dalecarlia	233	80	0	26	0	7	0	Wood	1	13	Washington, D. C.
Delta	830	175	0	38	0	8	4	Steel	3	37	St. Louis (M. R. C.).
Deluge	170	80	0	21	0	4	2	Wood			Pittsburgh.
Epsilon	650	157	0	40	0	7	6	Steel	3	37	St. Louis (M. R. C.).
Etna [2]	280	130	0	28	0	5	0	Wood	5	13	Rock Island.
Flad, Henry	860	192	0	44	0	7	0	Steel	3	40	St. Louis (M. R. C.).
Florida [3]	371	152	0	29	9	7	0	...do	4	17	Jacksonville.
Fort Chartres	815	197	0	45	0	7	6	...do	14	42	St. Louis.
Fort Gage	815	197	0	45	0	7	6	...do	14	42	Do.
Gamma	581	138	0	38	0	7	10	...do	3	33	St. Louis (M. R. C.).
Geyser	141	100	0	24	0	4	5	Wood and steel.	5	14	Rock Island.
Gulfport	886	150	0	40	0	11	6	Steel	11	31	Mobile, Ala.
Hampton	91	60	0	23	0	6	0	Wood	2	5	Norfolk.
Harrod, B. M	1,270	210	0	44	0	8	6	Iron and steel.	3	44	St. Louis (M. R. C.).
Hecla	217	120	0	26	0	5	0	Wood	5	14	Rock Island.
Humphreys, Chas	234	129	9	32	0	8	9	...do	5	20	Mobile.
Indiana	417	125	0	34	0	6	10	Steel	1	27	Cincinnati (1st).
Iota	800	192	0	44	0	7	0	...do			St. Louis.
Jacksonville	900	137	4	40	8	9	5	Wood	2	28	Jacksonville.
Kappa	860	192	0	44	0	7	0	Steel	3	40	St. Louis (M. R. C.).
Ludlow, Gen	400	162	1	36	9	4	0	...do			Grand Rapids.
Macon	101	74	0	28	0	4	6	...do			Savannah.
Mallery, Maj. J. C	666	130	0	32	0	9	0	...do	8	31	Jacksonville, Fla.
McGregor, Robert	700	206	9	44	4	7	0	...do	7	54	Little Rock.
Mayon	309	130	5	28	0	5	5	...do	5	13	Savannah.
Miller, Col. A. M	710	138	6	37	0	13	0	Wood	5	55	Galveston.
Morgan	667	134	5	38	0	8	0	Steel	6	38	Savannah.
Multnomah	1,135	269	5	39	0	9	6	...do	8	32	Portland, Oreg. (2d).
Muscogee	309	120	0	30	0	7	6	Wood	2	6	Montgomery.
No. 1-OR [1]		80	0	22	0	4	2	...do			Pittsburgh.
No. 6	91	90	0	24	0	5	0	Composite			Mobile, Ala.
Orange	547	115	0	36	0	9	6	Wood	2	20	Dallas.
Oregon	535	120	0	36	0	11	0	...do	3	29	Portland, Oreg. (1st).
Pascagoula	771	150	0	40	0	10	6	Steel	10	30	Mobile.
Pelee	250	119	0	30	0	5	0	Wood	4	14	Rock Island.
Pettus	488	135	0	35	0	6	6	...do	3	23	Montgomery.
Portland	131	100	0	22	0	5	0	Steel		7	Louisville.
Pump boat No. 1	113	90	0	24	0	3	6	Wood		5	Chattanooga.
Ram	419	125	0	30	0	7	0	Steel	6	20	New Orleans (M. R. C.).
Sacramento	984	150	0	40	0	11	6	...do	11	31	San Francisco (3d).
San Bernard	440	83	0	32	0	7	6	Wood	8	32	Galveston.
San Joaquin	984	150	0	40	0	11	6	Steel	11	31	San Francisco (3d).
San Pedro	834	140	8	40	8	10	7	...do	7	27	Los Angeles.
Selma	600	160	0	40	0	6	0	...do	14	39	St. Louis.
Shippingport	131	100	0	22	0	5	0	...do		7	Louisville.
Taal	299	130	0	28	0	5	0	Wood, steel, and concrete.	5	13	Rock Island.
Taber, H. S	700	206	9	44	4	7	0	Steel	7	54	Little Rock.
Talcot, Capt. Andrew	588	111	8	32	0	9	7	Wood	8	28	New York (1st).
Thebes	600	160	0	40	0	6	0	Steel	14	39	St. Louis.
Tortoise	196	102	0	24	0	5	3	Wood		7	Duluth.
Uncle Sam	450	85	0	34	0	7	0	...do	2	12	Philadelphia.
Vesuvius [3]	244	114	10	30	0	5	0	...do	4	14	Rock Island.
Wahalak	886	150	0	40	0	11	6	Steel	11	29	Mobile.
Wahkiakum	1,135	269	5	39	0	9	6	...do	8	32	Portland, Oreg. (2d).
Warroad	260	118	6	27	0	8	6	Wood	2	7	St. Paul.
Waterway	417	163	0	37	0	7	0	Steel	5	30	Vicksburg.
Zeta	650	157	0	40	0	7	6	...do	3	40	St. Louis (M. R. C.).

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[1] Rebuilding.
[2] Double crew.
[3] Combination hydraulic and bucket dredge.

TABLE 3.—DIPPER DREDGES.

Name, number, or letter.	Displacement.	Dimensions.						Material.	Complement.		District.
		Length.		Breadth.		Depth.			Officers.	Men.	
	Tons.	*Ft.*	*in.*	*Ft.*	*in.*	*Ft.*	*in.*				
Adams, Col. M. B.	417	112	0	34	0	7	3	Steel	1	7	Wheeling.
Addison	177	75	0	30	0	7	2	Wood	......	6	Do.
Ajax	124	73	0	26	0	6	0	...do	1	6	Rock Island.
Algoma	258	78	6	30	4	7	2	...do	1	7	Milwaukee.
Apache	217	80	0	30	0	8	0	...do	1	6	Rock Island.
Appleton	214	90	0	32	0	7	0	...do	1	5	Milwaukee.
Asotin	200	140	0	28	0	5	0	...do	3	15	Portland, Oreg. (1st).
Attalla	206	75	0	26	4	5	6	...do	2	6	Montgomery.
Autauga	128	75	0	26	4	5	6	...do	2	6	Do.
Carrollton	250	80	0	30	0	6	9	...do	......	9	Cincinnati (2d).
Champoeg	165	80	0	30	0	5	0	...do	1	9	Portland, Oreg. (2d).
Cheraw	620	155	0	28	0	7	1	Steel	2	12	Charleston, S. C.
Cincinnati	262.7	112	0	34	0	6	10	Steel and iron.	......	......	Cincinnati (1st).
Davenport	348	110	0	40	0	6	0	Composite.	......	6	Rock Island.
Farquhar, Col	250	76	0	24	0	6	0	Wood	......	......	Grand Rapids.
Frankfort	115	72	0	19	0	5	5	...do	......	9	Cincinnati (2d).
Frontenac	172	76	0	26	0	6	7	...do	2	6	Buffalo.
Green River	268	112	0	31	0	4	0	...do	1	7	Louisville.
Illinois	280	90	0	34	0	8	0	...do	1	4	Chicago.
Kentucky	326	100	0	34	0	6	10	...do	......	10	Chattanooga.
Keokuk	348	110	0	40	0	6	0	Composite.	......	6	Rock Island.
Kewaunee	443	100	0	34	0	9	0	...do	1	16	Milwaukee.
Kwasind	187	80	0	28	0	6	6	Wood	......	8	Chattanooga.
Louisville	128	67	0	28	0	6	0	Iron	......	6	Louisville.
Marietta	263	115	6	34	0	6	6	Steel	......	......	Cincinnati (1st).
Maumee	549	100	0	36	0	11	0	Wood	2	11	Cleveland.
Ohio	270	112	0	31	6	6	8	Iron	1	13	Cincinnati (1st).
Oswego	235	94	0	31	6	6	1	...do	1	10	Do.
Otter Tail	120	75	0	24	0	6	0	Wood	2	7	St. Paul.
Phoenix	186	80	0	30	0	8	0	...do	1	5	Rock Island.
Sodus	375	100	0	35	0	9	2	...do	2	8	Buffalo.
St. Paul	348	110	0	40	0	6	0	Composite.	......	6	Rock Island.
Tellico	190	75	0	26	0	7	0	...do	......	10	Chattanooga.
Tennessee	375	100	0	34	0	6	10	...do	......	10	Do.
Tuscumbia	375	100	0	34	0	6	10	...do	......	10	Do.
Upatoi	212	85	0	30	0	6	0	Wood	2	8	Montgomery.
Vulcan	240	80	0	30	0	8	0	...do	1	5	Rock Island.
Wallowa	175	125	0	25	6	5	0	...do	3	11	Portland, Oreg. (1st).
Watauga	400	100	0	34	0	7	10	...do	......	10	Chattanooga.
Wolf	73	80	0	28	0	4	6	...do	2	5	Memphis (M. R. C. 1st and 2d).
No. 1	187	79	10	30	0	7	4	...do	......	5	Chicago.
No. 1	200	80	0	30	0	7	0	...do	......	5	Nashville.
No. 1	303	85	0	32	0	7	0	...do	2	7	Pittsburgh.
No. 1	115	65	0	27	0	6	6	...do	......	......	Galveston.
No. 2	197	86	6	30	0	4	8	...do	2	7	Pittsburgh.
No. 68	220	104	7	30	6	5	4	...do	1	7	Little Rock.
No name	159	65	0	26	2	6	5	...do	2	3	Norfolk.

TABLE 4.—BUCKET DREDGES.

Name, number, or letter.	Displacement.	Dimensions.						Material.	Complement.		District.
		Length.		Breadth.		Depth.			Officers.	Men.	
	Tons.	*Ft.*	*in.*	*Ft.*	*in.*	*Ft.*	*in.*				
Ajax	400	82	6	32	8	10	4	Wood	2	9	Wilmington, N. C.
Alabama [1]	244	80	0	38	0	6	0	...do		7	Chattanooga.
Albany	75	70	0	30	0	4	9	...do	1	6	Montgomery.
Barataria	302	102	0	36	0	6	1	...do	3	16	Miss. River (4th).
Buras	341	110	0	40	0	7	3	...do	4	8	New Orleans (M. R. C. 4th).
Cascade	90	60	0	30	0	5	0	...do	1	7	Portland, Oreg. (1st).
Casey	163	86	0	28	0	6	5	...do	1	4	Louisville, Ky.
Cowlitz	162	78	0	34	0	5	6	...do	1	9	Portland, Oreg. (2d).
Grossetete	258	80	4	34	3	5	0	...do	3	9	New Orleans.
Hell Gate	720	110	0	35	0	12	0	...do			Philadelphia.
Hercules	670	100	0	38	0	11	4	...do	1	11	Wilmington, N. C.
Malta [1]	160	70	0	31	4	6	10	...do		9	Cincinnati (2d).
Nolichucky	252	85	0	30	0	6	10	...do			Chattanooga.
Omro	150	100	0	30	0	6	0	...do	1	4	Milwaukee.
Oriole	85	107	0	22	4	5	0	...do	2	9	St. Paul.
Oshkosh [1]	234	75	0	31	0	6	0	...do	1	9	Milwaukee.
Rosecrans [1]	176	111	0	22	0	5	0	...do	1	5	Wheeling.
Saginaw	92	83	9	28	0	6	7	...do		4	Grand Rapids.
Scuppernong	220	78	0	32	0	7	0	...do	2	8	Wilmington, N. C.
Tishomingo	481	100	0	44	0	6	0	...do		10	Chattanooga.
No. 1	120	92	0	30	0	4	4	...do	2	6	Kansas City, Mo.
No. 1	115	65	0	27	0	6	6	...do			Galveston.
No. 2 derrick boat	149	70	0	22	0	6	10	...do	1	11	Charleston, S. C.
No. 6 Hudson River [2]	244	85	0	28	0	9	4	...do	1	4	New York (1st).
No. 21 Hudson River [2]	170	86	0	27	6	8	6	...do	2	12	Do.

[1] Ladder dredge.

[2] Gravel digging and screening plants.

TABLE 5.—SNAG BOATS.

Arkansas	235	155	6	30	0	4	6	Steel	3	20	Little Rock.
Black Warrior	305	159	7	33	2	4	4	Wood	2	15	Mobile.
Chattahoochee	233	140	0	29	0	4	0	...do	3	22	Montgomery.
Choctawhatchee	115	90	0	24	0	3	6	...do	2	8	Do.
Columbia	137	137	4	27	0	4	0	...do	3	20	Vicksburg.
Conecuh	37	60	0	20	0	3	0	...do	1	8	Montgomery.
Culberson, C. A	200	106	0	28	0	5	0	...do	4	12	Dallas.
Delatour [1]	350	112	0	30	0	5	0	...do	5	10	New Orleans.
Demopolis	96	82	3	25	6	4	9	...do	2	11	Mobile.
Escambia	112	92	0	25	0	4	0	...do	2	8	Montgomery.
Escatawpa	62	60	0	20	0	4	0	...do	2	11	Mobile.
Flint	127	95	0	24	0	4	0	...do	3	9	Montgomery.
Florence, Thos. B	107	109	6	20	0	4	0	Iron and steel.	3	9	Vicksburg.
Geneva	42	64	0	22	6	4	4	Wood	2	8	Montgomery.
Guadalupe	227	118	0	28	0	5	11	...do	2	10	Galveston.
Howell, C. W	304	166	0	36	0	5	0	Iron and steel.	3	23	Vicksburg.
Humphreys, Ben	286	155	6	32	0	5	0	...do	3	23	Do.
Johnson, A. B	58	84	0	22	0	3	0	Wood	1	11	Little Rock.
Kentucky	370	107	0	30	0	5	6	...do	4	12	Cincinnati (2d).
Kissimmee	65	60	0	18	0	4	0	...do	2	5	Jacksonville.
Macomb, J. N	1,160	177	6	62	0	8	0	Steel	6	36	St. Louis.
Mammoth Cave	284	141	0	32	8	5	0	...do	3	15	Louisville.
Mandan	150	156	0	24	0	4	7	...do	3	14	Kansas City.
Mathloma	177	140	0	34	0	5	0	Wood	3	11	Portland, Oreg. (2d).
McCalla, R. C	133	119	6	28	3	5	0	...do	4	20	Mobile.
McPherson, James B	340	194	10	36	0	5	7	Steel	5	18	Kansas City.
Missouri	510	187	0	52	0	7	0	...do	6	36	Do.
Navasota	140	90	0	25	0	5	0	Wood	2	12	Dallas.
Oconee	126	110	0	38	0	4	4	...do	3	11	Savannah.

[1] Snag boat and bucket dredge.

Name, number, or letter.	Displacement.	Dimensions.						Material.	Complement.		District.
		Length.		Breadth.		Depth.			Officers.	Men.	
	Tons.	*Ft.*	*in.*	*Ft.*	*in.*	*Ft.*	*in.*				
Pearl	128	96	6	26	0	5	0	Wood	3	11	Mobile.
Peded	317	131	8	26	0	5	3	Steel	2	12	Charleston, S. C.
Quapaw	240	147	6	30	0	4	4	...do	3	19	Little Rock.
Ransdell, Jos. E	286	155	6	32	0	5	0	Iron and steel.	3	23	Vicksburg.
Rattler	182	70	0	30	0	7	0	Wood	......	......	Philadelphia.
Reese, C. B	340	195	9	36	0	5	3	Iron and steel.	3	27	Little Rock.
Riverside	57	84	0	22	0	3	0	Wood	1	11	Do.
Roanoke [1]	232	115	0	24	0	5	10	...do	3	5	Norfolk.
Seizer	240	136	6	34	11	4	8	...do	3	29	San Francisco (3d).
Skagit	205	115	0	31	0	5	0	...do	3	8	Seattle.
Swan	264	159	0	31	4	4	6	Steel	3	11	Pittsburgh.
Tipton, David	265	164	0	34	0	5	0	Wood	7	19	Rock Island.
Tombigbee	151	119	0	28	0	5	4	...do	3	14	Mobile.
Trent	120	70	0	20	0	5	0	...do	2	8	Wilmington, N. C.
Trinity	190	123	5	30	0	3	0	...do	4	12	Dallas.
Tugaloo	336	129	3	34	0	5	6	Steel and wood.	3	12	Savannah.
Turtle, Capt	75	65	0	30	0	4	6	...do	......	10	Wheeling.
Twining, Wm. J	370	155	0	30	0	4	0	...do	4	15	Montgomery.
Umatilla [2]	300	159	9	34	4	5	1	Wood	3	14	Portland, Oreg. (1st).
Vienna	152	117	6	26	0	4	6	...do	3	12	Mobile.
Waco	200	118	8	30	2	5	0	...do	4	12	Dallas.
Wateree	317	131	8	26	0	5	3	Steel	2	12	Charleston, S. C.
Woodruff, E. A	863	226	0	48	0	7	6	Iron, steel, and wood.	6	34	Cincinnati (1st).
Wright, Gen. H. G	130	89	0	23	6	5	6	Wood	2	7	Wilmington, N. C.
Wright, H. G	1,100	187	0	62	0	8	0	Steel	6	36	St. Louis.
York	110	72	0	22	0	6	0	Wood	......	......	Washington, D. C.
No. 1	64	90	0	24	0	2	6	...do	1	15	Nashville.
No. 1	35	54	0	18	0	4	0	...do	2	4	Savannah.
No. 2, derrick barge	65	50	0	22	0	7	0	...do	......	......	Galveston.
No. 1, derrick barge	95	60	0	20	0	6	0	...do	......	......	Charleston.

[1] Snag boat and bucket dredge.

[2] Snag boat and rake dredge.

TABLE 6.—DERRICK BOATS.

A	110	80	0	28	0	4	0	Wood	1	6	Charleston.
Black	35	45	0	20	0	3	9	...do	1	7	Wilmington, N. C.
C	29	46	0	32	0	3	6	...do	......	......	Mobile.
Contentnia	32	40	0	20	0	4	0	...do	1	6	Wilmington, N. C.
D. B. No. 4	140	70	0	26	1	2	8	...do	1	8	Galveston.
Mary Ann	161	115	0	27	0	3	8	...do	......	......	Pittsburgh.
Mingo	116	94	0	32	0	5	0	Steel	......	5	Cincinnati (1st).
Rattler	240	70	0	30	0	7	0	Wood	2	11	Philadelphia.
Sapelo	160	85	4	39	8	5	5	...do	1	11	Savannah.
Tallahatta	81	50	0	40	0	5	0	...do	......	......	Mobile.
6	185	102	6	32	0	7	10	...do	......	......	Duluth.
7	185	102	6	32	0	7	10	...do	......	......	Do.
8	80	80	0	30	0	4	0	Wood	......	2	Chattanooga.
8	40	70	0	20	0	5	7	...do	......	......	Duluth.
9	104	80	0	30	0	4	9	...do	......	4	Chattanooga.
1017	74	90	0	32	0	5	0	Creosoted wood.	......	5	Memphis (M. R. C. 1st and 2d).
No. 1	107	70	0	32	0	5	0	Wood	......	......	Cincinnati (1st).
No. 1	50	34	3	13	2	3	0	...do	......	......	Chicago.
No. 1	115	65	0	27	0	5	6	...do	1	14	Galveston.
No. 1	81	66	6	29	6	5	10	...do	......	2	Milwaukee.
No. 1	142	100	0	30	0	4	9	...do	1	1	New Orleans.
No. 1	78	63	0	24	0	5	0	...do	......	......	Do.
No. 1	84	74	0	26	0	5	0	...do	2	3	Buffalo.
No. 1	51	65	0	20	5	3	10	...do	......	......	Portland, Oreg. (1st).
No. 1	42	51	0	22	6	2	10	...do	......	......	Portland, Oreg. (2d).
No. 1	42	60	0	20	0	6	0	...do	......	......	Savannah.
No. 1	75	68	0	20	0	3	1	...do	......	......	St. Louis.
No. 1	105	95	0	32	0	2	6	...do	1	16	Vicksburg.
No. 1, It	47	50	0	22	0	4	2	...do	......	......	Pittsburgh.
No. 1, G. & B	76	70	0	26	0	4	0	...do	......	2	Louisville.

Name, number, or letter.	Displacement.	Dimensions.						Material.	Complement.		District.
		Length.		Breadth.		Depth.			Officers.	Men.	
	Tons.	*Ft.*	*in.*	*Ft.*	*in.*	*Ft.*	*in.*				
No. 1, O. R	87	71	0	37	0	4	0	Wood			Pittsburgh.
No. 1, O. R	131	70	0	32	0	5	0	Steel		2	Louisville.
No. 2	107	70	0	32	0	5	0	Wood			Cincinnati (1st).
No. 2	65	64	0	22	0	7	0	do		10	Galveston.
No. 2[1]	122	74	0	36	0	6	0	do			Manila.
No. 2	131	84	2	27	4	6	8	do		2	Milwaukee.
No. 2	106	76	0	26	0	6	3	do	2	3	Buffalo.
No. 2	65	59	0	22	0	5	8	do			New Orleans.
No. 2	70	70	0	26	0	3	8	do			Pittsburgh.
No. 2	84	70	0	30	0	4	0	do	1	9	Portland, Oreg. (1st).
No. 2	42	51	0	22	6	2	10	do			Portland, Oreg. (2d).
No. 2	75	68	0	20	0	3	1	do			St. Louis.
No. 2	54	65	0	24	0	3	0	do	2	18	Vicksburg.
No. 2, U. S. E. D. Wheeling.	113	74	9	34	11	4	1	do		1	Wheeling.
No. 2, G. & B	76	70	0	26	0	4	0	do		5	Louisville.
No. 2, O. R	131	70	0	32	0	5	0	Steel		2	Do.
No. 3	74	80	0	24	0	4	6	Wood		4	Chattanooga.
No. 3	236	50	0	42	0	12	0	Steel			Detroit.
No. 3	90	67	0	30	0	4	0	Wood		3	Little Rock.
No. 3	128	100	0	30	0	4	9	do	1	1	New Orleans.
No. 3	45	54	0	22	0	3	8	do		9	Galveston.
No. 3	60	75	0	30	0	5	0	do		5	Memphis (M. R. C. 1st and 2d).
No. 3	44	80	0	20	0	4	9	do			Milwaukee.
No. 3	144	80	0	30	0	4	7	do		2	Nashville.
No. 3	90	70	0	26	7	4	0	do			Pittsburgh.
No. 3	42	51	0	22	6	2	10	do			Portland, Oreg. (2d).
No. 3, U. S. E. D. Wheeling.	185	75	0	35	0	4	7	do		1	Wheeling.
No. 3, G. & B	76	70	0	26	0	4	0	do		6	Louisville.
No. 4	49	80	0	30	0	3	0	do			Chattanooga.
No. 4	91	80	0	30	0	4	0	do			Do.
No. 4	9	29	6	10	0	3	10	do			Los Angeles.
No. 4	44	80	0	20	0	4	9	do			Milwaukee.
No. 4	98	70	0	32	0	4	7	do		2	Nashville.
No. 4	65	65	0	30	0	4	4	do		1	Cincinnati (2d).
No. 4	42	51	0	22	6	2	10	do			Portland, Oreg. (2d).
No. 5, L. P. C	57	72	0	22	0	4	0	do		2	Louisville.
No. 5	250	100	0	34	0	6	10	do		3	Chattanooga.
No. 5	19	40	0	18	0	3	6	do			Los Angeles.
No. 5	98	70	0	32	0	4	7	do			Nashville.
No. 5	166	75	6	28	6	7	0	do			Manila.
No. 5	50	38	0	18	0	6	0	do			Philadelphia.
No. 5	65	65	0	30	0	4	10	Steel		1	Cincinnati (2d).
No. 6	85	80	0	30	0	4	0	Wood			Chattanooga.
No. 7	85	80	0	30	0	3	6	do		2	Do.
No. 7, L. K	95	70	0	22	0	4	10	do			Wheeling.
No. 10	140	80	0	30	0	4	0	do		4	Chattanooga.
No. 11	90	80	0	30	0	4	0	do			Do.
No. 12	90	80	0	30	0	4	0	do			Do.
No. 13	91.5	80	0	30	0	4	0	do		3	Do.
No. 14	90	80	0	30	0	4	0	do			Do.
No. 16, Hudson River.	170	80	0	26	6	6	0	do	2	2	New York (1st).
No. 19, Hudson River.	170	80	9	27	4	7	6	do	2	2	Do.
No. 20, Hudson River.	145	81	0	27	6	8	6	do	2	2	Do.
No. 24, U. S. E. D. Wheeling.	161	75	0	35	0	4	10	do	1	2	Wheeling.
No. 29, U. S. E. D. Kanawha.	41	62	0	24	0	3	8	do			Do.
No. 116	69	69	0	29	0	4	0	do	1	20	Vicksburg.
No. 297	42	100	0	20	0	4	6	do	1	4	Rock Island.
No. 319	65	70	0	26	0	4	0	do	1	4	Do.
No. 596	170	120	0	30	0	6	0	do	2	6	Vicksburg (3d M. R. C.).
No. 1309	100	86	0	35	0	5	0	do	2	6	Do.
Hudson	200	71	0	24	0	7	0	do			New York (1st).
No name	43	42	11	15	11	3	9	do		3	Norfolk.
No name	132	80	0	36	0	5	0	do	1	1	St. Louis (M. R. C.).
No name		76	0	22	0	6	5	do			Detroit.
Wolf, L. C	114	60	6	32	6	4	7	do	1	2	Wheeling.

[1] Condemned and destroyed 1914.

TABLE 7.—PILE DRIVERS.

Name, number, or letter.	Displacement.	Dimensions.			Material.	Complement.		District.
		Length.	Breadth.	Depth.		Officers.	Men.	
	Tons.	*Ft. in.*	*Ft. in.*	*Ft. in.*				
No. 1, G. R	24	40 0	20 0	3 0	Wood			Grand Rapids.
No. 1	57	76 0	19 0	4 4	...do	2	4	Kansas City.
No. 1-B	57	76 0	19 0	4 4	...do	2	4	Do.
No. 1	111	66 4	21 4	6 6	...do		2	Milwaukee.
No. 1	12	81 0	22 0	4 0	...do			Montgomery.
No. 1	71	55 0	25 0	4 0	...do			New Orleans.
No. 1	68	50 0	26 6	4 0	...do			Pittsburgh.
No. 1	36	60 0	22 0	3 6	...do		3	Portland, Oreg. (2d).
No. 1	20	45 3	17 0	3 6	...do			Savannah.
No. 1	75	68 0	20 0	3 1	...do		8	St. Louis.
No. 1, O. R	88	70 0	22 0	4 5	...do		10	Louisville.
No. 2, O. R	88	70 0	22 0	4 5	...do		10	Do.
No. 2	118	60 0	25 4	6 6	...do		2	Milwaukee.
No. 2	14	40 0	18 0	3 0	...do			Montgomery.
No. 2[1]	127	75 6	30 0	5 0	...do			New Orleans.
No. 2	66	50 0	26 4	4 7	...do		7	Pittsburgh.
No. 2	82	70 0	24 0	4 0	...do		5	Portland, Oreg. (2d).
No. 2	63	76 0	19 0	4 4	...do	2	8	Kansas City, Mo.
No. 3	63	76 0	19 0	4 4	...do	2	8	Do.
No. 3	88	70 0	22 0	4 5	...do		10	Louisville.
No. 3	8.8	30 0	16 0	2 0	...do			Montgomery.
No. 3	75	68 0	20 0	3 1	...do		8	St. Louis.
No. 4	56	57 0	24 0	3 6	...do		6	Duluth.
No. 4	17.5	40 0	18 0	3 0	...do		8	Montgomery.
No. 4	75	68 0	20 0	3 1	...do		8	St. Louis (M. R. C.).
No. 4, Hudson River.	50	50 0	21 0	3 1	...do	1	5	New York (1st).
No. 4	63	76 0	19 0	4 4	...do	2	8	Kansas City, Mo.
No. V-S	49	65 0	19 0	4 6	...do	2	4	Kansas City.
No. 5	63	76 0	19 0	4 4	...do	2	8	Kansas City, Mo.
No. 5	12	40 0	18 0	3 0	...do		8	Montgomery.
No. 5	75	68 0	20 0	3 1	...do		8	St. Louis.
No. 5, Hudson River.	55	50 0	21 7	3 2	...do	1	5	New York (1st).
No. 6	50	50 0	28 0	3 10	...do			Cincinnati (2d).
No. 6	63	76 0	19 0	4 4	...do	2	8	Kansas City, Mo.
No. 6	57	70 0	20 0	3 0	...do		6	Memphis (M. R. C. 1st and 2d).
No. VII-Y	57	76 0	19 0	4 4	...do	4	4	Kansas City.
No. 9	57	70 0	20 0	3 0	...do		6	Memphis (M. R. C. 1st and 2d).
No. 11	30	80 0	22 0	4 2	...do			Montgomery.
No. 13	54	68 0	20 0	3 6	...do	1	4	St. Louis (M. R. C.).
No. 15	57	76 0	19 0	4 4	...do	4	4	Kansas City.
No. 17	10	40 0	18 0	3 0	...do			Montgomery.
No. 25	75	68 0	20 0	3 1	...do		8	St. Louis.
No. 26	17.5	40 0	18 0	3 0	...do			Montgomery.
No. 26	75	68 0	20 0	3 1	...do		8	St. Louis.
No. 28	75	68 0	20 0	3 1	...do		8	Do.
No. 29	75	68 0	20 0	3 1	...do		8	Do.
No. 30	75	68 0	20 0	3 1	...do		8	Do.
No. 31	75	68 0	20 0	3 1	...do		8	Do.
No. 32	75	68 0	20 0	3 1	...do		8	Do.
No. 33	47	66 0	20 0	4 6	...do		5	Rock Island.
No. 33	75	68 0	20 0	3 1	...do		8	St. Louis.
No. 34	75	68 0	20 0	3 1	...do		8	Do.
No. 35	75	68 0	20 0	3 1	...do		8	Do.
No. 101	106	88 0	25 0	2 4	Steel	2	6	Do.
No. 102	106	88 0	25 0	2 4	...do	2	6	Do.
No. 103	106	88 0	25 0	2 4	...do	2	6	Do.
No. 104	106	88 0	25 0	2 4	...do	2	6	Do.
No. 104		65 0	18 0	3 0	...do			Rock Island.
No. 503	58	66 0	22 0	4 3	Composite.		4	Do.
No. 551	84	100 0	25 0	5 0	Wood	2	8	Kansas City, Mo.
No. 971	56	76 0	25 0	3 10	...do	1	4	St. Louis (M. R. C.).
No. 981	56	76 0	25 0	3 10	...do	1	4	Do.
No. 982	56	76 0	25 0	3 10	...do	1	4	Do.
No. 983	56	76 0	25 0	3 10	...do	1	4	Do.
No name		43 0	20 0	3 9	...do			New York (1st).
Lilliput	82	60 0	24 0	5 1	...do			Wilmington, N. C.
Tackle	58	64 0	28 0	3 6	...do			San Francisco (3d).

[1] Pile driver and derrick.

TABLE 8.—GRADERS.

Name, number, or letter.	Displacement.	Dimensions.						Material.	Complement.		District.
		Length.		Breadth.		Depth.			Officers.	Men.	
	Tons.	*Ft.*	*in.*	*Ft.*	*in.*	*Ft.*	*in.*				
No. 1	280	124	0	30	0	7	7	Wood		20	New Orleans (M. R. C. 4th).
No. 2	150	110	0	30	0	5	0	do		11	Memphis (M. R. C. 1st and 2d).
No. 2	280	124	0	30	0	7	7	do		20	New Orleans (M. R. C. 1st and 2d).
No. 101[1]	126	88	0	25	0	2	4	Steel	2	9	St. Louis.
No. 102[1]	126	88	0	25	0	2	4	do	2	9	Do.
No. 1011	229	120	0	30	0	6	0	Wood	3	18	Vicksburg (3d M. R. C.).
No. 1012	220	120	0	30	6	6	0	do	3	18	Do.
No. 1022	180	110	0	30	0	6	0	Creosoted		11	Memphis (1st and 2d M. R. C.).
No. 1205	190	120	11	30	2	7	0	Steel		11	Do. Do.
No. 9313	115	100	4	27	3	4	0	Wood		11	Do.
IV-EP		70	0	19	10	5	0	do			Kansas City.

[1] Combined grader and derrick boat.

TABLE 9.—DRILL BOATS.

Newton, Gen. John	750	127	0	58	0	9	6	Wood			Philadelphia.
No. 1	50	65	0	20	0	3	8	do			Portland, Oreg. (1st).
No. 1, Columbia River	100	100	0	26	6	4	6	do			Seattle.
No. 1, U. S. E. D. Hudson River.	30	42	0	20	6	3	2	do			New York (1st).
No. 2	45	25	0	6	0	1	0	do			Chattanooga.
No. 2	50	65	0	20	0	3	8	do			Portland, Oreg. (1st).
No. 2, Columbia River	100	100	0	26	6	4	6	do			Seattle.
No. 3	45	25	0	6	0	1	0	do			Chattanooga.
No. 3	50	65	0	20	0	3	8	do			Portland, Oreg. (1st).
No. 3, Columbia River	100	100	0	26	6	4	6	do			Seattle.
No. 4	45	25	0	6	0	1	0	do			Chattanooga.
No. 5	45	25	0	6	0	1	0	do			Do.
No. 6	45	25	0	6	0	1	0	do			Do.
No. 6	77	80	0	20	0	4	0	do			Rock Island.
No. 7	45	25	0	6	0	1	0	do			Chattanooga.
No. 8	45	25	0	6	0	1	0	do			Do.
No. 9	45	25	0	6	0	1	0	do			Do.
No. 10	45	25	0	6	0	1	0	do			Do.
No. 10	10	40	0	14	0	2	8	do		4	Louisville.
No. 11	45	25	0	6	0	1	0	do			Chattanooga.
No. 11	10	40	0	14	0	2	8	do		5	Louisville.
No. 12	45	25	0	6	0	1	0	do			Chattanooga.
No. 12	10	40	0	14	0	2	8	do		4	Louisville.
No. 15	10	40	0	14	0	2	8	do		4	Do.
No. 16	10	40	0	14	0	2	8	do		4	Do.
No. 16	60	68	0	26	0	5	0	do			Montgomery.
No. 39, U. S. E. D. Hudson River.	200	71	0	24	0	7	0	do	1	12	New York (1st).
No. 103		81	0	18	0	4	0	do			Rock Island.
No. 426	272	132	0	32	0	6	0	Steel		16	Do.

TABLE 10.—MANEUVER BOATS.

Name, number, or letter.	Displacement.	Dimensions.			Material.	Complement.		District.
		Length.	Breadth.	Depth.		Officers.	Men.	
	Tons.	*Ft. in.*	*Ft. in.*	*Ft. in.*				
No. 1	15	45 10	16 0	3 4	Wood			Dallas.
No. 1	36	50 0	20 0	3 4	...do			Cincinnati (2d).
No. 1	71	74 10	22 0	4 7	...do		5	Louisville.
No. 1	57	60 0	22 0	3 5	...do			Charleston.
No. 1, A. R	41	56 0	18 0	3 0	...do			Pittsburgh.
No. 2	22	44 1	20 0	3 7	...do			Dallas.
No. 2	71	74 10	22 0	4 7	...do		5	Louisville.
No. 2, O. R	70	60 0	22 0	4 0	...do			Pittsburgh.
No. 3	50	60 0	26 0	3 4	...do			Cincinnati (2d).
No. 3, O. R	54	60 0	20 0	4 0	...do			Pittsburgh.
No. 4, O. R	58	60 0	22 0	3 8	...do			Do.
No. 5, O. R	65	60 0	22 0	3 8	...do			Do.
No. 6, O. R	41	56 0	18 0	3 0	...do			Do.
No. 8, O. R	65	60 0	22 0	3 8	...do			Do.
No. 10, U. S. E. D. Wheeling.	60	60 0	22 0	3 8	...do			Wheeling.
No. 11, U. S. E. D. Wheeling.	60	60 0	22 0	3 8	...do			Do.
No. 22, U. S. E. D. Wheeling.	60	60 0	22 0	3 8½	...do			Do.
No. 23, U. S. E. D. Wheeling.	60	60 0	22 0	3 8½	...do			Do.
No. 38	65	65 0	30 0	5 2	...do			Cincinnati (2d).
No. 39	50	60 0	26 0	3 4	...do			Do.
No. 45	75	65 0	30 0	4 10	Steel			Do.
No. 46	55	60 0	26 0	3 6	...do			Do.
No. 47 [1]	55	60 0	26 0	3 6	...do			Do.
No name	71	75 0	22 0	3 3	Wood			Cincinnati (1st).
No. 9113	36	60 0	25 0	4 0	...do			Vicksburg.
No. 9122	75	80 0	30 0	4 0	...do			Do.
No. 9127	50	60 0	25 0	4 0	...do			Do.

[1] Authorized after June 30, 1914.

TABLE 11.—TUG AND SURVEY BOATS, SCREW (STEAM).

Name, number, or letter.	Displacement.	Length.	Breadth.	Depth.	Material.	Officers.	Men.	District.
Adams, H. M	95	78 4	18 9	7 6	Wood	2	2	Portland, Oreg. (2d).
Alexander, Gen	110	77 6	18 4	8 0	...do			San Francisco (2d).
Angler	95	91 3	17 2	10 0	...do			Savannah.
Arago	90	89 6	18 0	9 0	...do	2	7	Portland, Oreg. (2d).
Ariadne	8	45 6	9 0	4 0	...do			Milwaukee.
Boaz	55	65 0	16 3	7 0	Iron	2	3	Vicksburg (M. R. C. 3d).
Brewerton	60	69 7	15 9	8 11	Wood	2	2	Buffalo.
Camden	170	80 0	20 0	9 0	Steel	2	5	Philadelphia.
Casey, T. L	90	70 0	15 0	8 0	...do	2	2	Buffalo.
Castle	165	95 0	20 2	10 6	...do	2	6	Washington, D. C.
Caswell, Richard	200	84 9	18 6	9 4	...do	2	7	Wilmington, N. C.
Cerebus	226	109 3	23 0	12 6	...do	4	5	New York (super. of N. Y. Harbor).
Chickasaw	155	109 0	18 8	9 9	...do	2	6	Mobile.
Chipeta	44	76 8	14 1	8 4	Wood			Norfolk, Va.
Circle	38	53 6	14 3	6 6	...do	2	1	Duluth.
Coquet	100	58 0	18 6	7 0	...do	2	6	Wilmington, N. C.
Cora	220	140 0	23 7	13 6	...do	2	9	Newport.
Cynthia	135	74 7	17 10	7 10	...do	2	6	Wilmington, N. C.
Dearborn	9	50 0	8 9	4 9	Steel			Chicago.
Donovan, C	180	95 0	19 2	10 0	...do	2	4	New Orleans.
Engineer	208	106 0	20 0	11 0	...do			Manila.
Engineer, N. Y	197	100 3	21 2	10 8	...do	2	6	New York (2d).
Essayons	130	85 0	21 0	11 6	...do	2	3	Duluth.
Gem	10.9	46 2	9 3	4 6	Wood			Savannah.

Name, number, or letter.	Displacement.	Dimensions.			Material.	Complement.		District.
		Length.	Breadth.	Depth.		Officers.	Men.	
	Tons.	Ft. in.	Ft. in.	Ft. in.				
Gibbon	124	61 9	19 0	8 8	Wood	2	11	Savannah.
Gillmore, Gen	47	61 6	15 0	4 10	...do	2	1	Grand Rapids.
Gladwin	(1)	118 5	18 4	9 9	...do	1	8	Detroit.
Gwendolen	8	30 0	8 0	4 6	...do	1	1	Buffalo.
Hancock	120	99 10	17 6	7 6	...do	2	7	Detroit (Lake Survey).
Harding, Horace	215	90 6	23 1	10 6	...do	2	6	Mobile.
Harwood, Col	107	80 0	17 8	9 6	...do	1	3	Boston.
Helen	33	56 0	12 0	5 9	...do	......	......	Galveston.
Hillsboro	86	114 0	14 6	6 4	...do	2	4	Jacksonville.
Humphreys, Gen. A. A.	50	73 8	16 6	7 1	...do	2	5	Philadelphia.
Industry	110	71 8	16 0	7 10	...do	[1] 4	4	Milwaukee.
Lamont	216	108 8	22 11	12 6	Steel	4	5	New York (super. of N. Y. Harbor).
Lusk, Col. J. L	295	123 11	19 4	11 10	Wood	2	12	Detroit (Lake Survey).
Manchac	113	78 0	17 0	7 0	...do	2	5	New Orleans (M. R. C. 4th).
Manisees	225	106 0	22 0	9 0	...do	4	5	New York (2d).
Manitowoc	200	100 0	21 6	10 7	Steel	4	6	Milwaukee.
Marengo	137	82 0	19 4	8 8	...do	2	5	New Orleans (M. R. C. 4th).
McGregor	79	87 6	14 3	7 1	Wood	3	4	Norfolk.
Mendell, G. H	150	101 0	21 2	10 0	...do	2	7	Portland, Oreg. (2d).
Mercur	60	83 0	13 3	7 0	Steel	2	3	Wilmington, N. C.
Morganza	180	94 0	20 4	10 3	...do	2	5	New Orleans (M. R. C. 4th).
Nimrod	245	106 11	22 8	10 8	Wood	4	5	New York (super. of N. Y. Harbor).
Nipinock	4	32 6	6 6	4 0	...do	1	1	New York (1st).
Noble, Alfred	83	76 6	15 6	7 0	Steel	1	3	Detroit.
Parker	98	69 9	16 4	7 2	Wood	2	2	Vicksburg (M. R. C. 3d, super. of N. Y. Harbor).
Philadelphia	55	67 0	16 0	7 6	Steel	2	5	Philadelphia.
Picket	32	52 5	11 11	6 3	Wood	1	3	New Orleans.
Pontonier	50	80 0	18 0	3 6	Steel	2	2	Washington Barracks, D. C.
Post, J. C	95	78 0	18 9	7 6	Wood	2	2	Portland, Oreg. (2d).
Quest	46	65 0	15 0	8 0	...do	2	3	Cleveland.
Reese, Gen	29	48 0	12 0	5 0	...do	1	3	New Orleans.
Rumsey, James	127	120 0	22 0	4 3	Steel	1	7	Wheeling.
San Pedro [2]	113	92 10	20 10	10 6	Iron	......	......	Manila.
Sapper	100	76 4	16 10	9 6	Wood	1	3	Detroit.
Scout	195	106 1	20 10	10 8	Steel	4	5	New York (super. of N. Y. Harbor).
Search	200	158 6	18 0	10 0	..do	2	11	Detroit (Lake Survey).
Sentinel	170	95 0	20 0	10 6	do	3	6	Baltimore.
Spear	160	87 0	19 8	11 0	Wood	2	4	Cleveland.
Surveyor	176	98 0	20 1	8 5	...do	2	12	Detroit (Lake Survey).
Talfor, Capt	130	80 0	16 2	8 0	...do	2	5	Galveston.
Thayer, Col	34	54 4	15 3	6 0	...do	1	3	New York (1st).
Tickfaw	217	94 0	20 4	10 0	Steel	2	5	New Orleans (4th M. R. C.).
Tonty	120	96 0	16 0	5 6	...do	2	5	New Orleans.
Totten, Gen	35	53 0	16 2	6 11	Wood	1	4	New York (1st).
Tunica	205	90 0	20 4	9 8	Steel	2	5	New Orleans (M. R. C. 4th).
Tuscaloosa	212	92 0	23 0	8 0	Wood	2	6	Mobile.
Uacha	43	62 0	12 0	7 5	Iron	2	3	New Orleans.
Vidette	124	110 0	14 9	7 7	Wood	2	5	Duluth.
Vidette	200	105 0	21 0	10 0	Steel	4	8	Philadelphia.
Vigilant	208	114 5	22 8	12 0	...do	4	7	New York (super. of N. Y. Harbor).
Visitor	145	95 6	18 0	6 4	...do	2	5	Cleveland.
Warren, Gen	75	72 2	17 0	5 0	Wood	......	......	Washington, D. C.
West Neebish	47	59 5	15 1	6 6	...do	1	2	Detroit.
Whitewater	61	83 0	19 0	9 0	Iron	2	3	Vicksburg (M. R. C. 3d).
Wilson	106	96 0	19 6	11 0	Steel	3	9	Seattle.
No. 1, U. S. L. S	56	70 0	13 6	6 6	Wood	2	4	Detroit (Lake Survey).
N. 2, U. S. L. S	48	70 5	14 6	7 6	...do	2	6	Do.

[1] Double crew.

[2] Sold to Quartermaster Corps, 1913.

TABLE 12.—TOW AND SURVEY BOATS, PADDLE (STEAM).

Name, number, or letter.	Displacement.	Dimensions.			Material.	Complement.		District.
		Length.	Breadth.	Depth.		Officers.	Men.	
	Tons.	*Ft. in.*	*Ft. in.*	*Ft. in.*				
Ada	25	68 0	11 0	3 0	Wood	2	4	Rock Island.
Alabama	219	134 5	25 6	4 4	...do	4	14	Montgomery.
Alert	135	115 0	19 6	3 10	...do	2	9	Rock Island.
Allen, A. D	150	137 10	23 6	4 0	...do	2	6	Little Rock.
Arethusa	92	110 0	22 0	4 4	...do	2	5	Kansas City.
Augustin, Lt	191	136 0	25 6	5 0	Steel	2	7	Do.
Aux Vasses	50	70 0	18 0	3 6	Wood	1	4	St. Louis.
Boone, Daniel	86	117 6	22 7	4 0	...do	2	7	Kansas City, Mo.
Boose, Henry	100	100 0	19 6	3 10	...do	2	8	Rock Island.
Brazos	15	54 6	13 6	2 10	...do	......	......	Galveston.
Cahokia	90	81 0	18 0	3 3	...do	1	4	St. Louis.
Cherokee	278	147 2	27 4	4 8	Steel	2	7	Louisville.
Chilowee	101	100 0	19 0	3 6	Wood	1	5	Chattanooga.
Chisca	450	185 6	30 3	5 0	...do	4	13	Memphis (M. R. C. 1st and 2d).
Choctaw	560	171 6	36 0	5 6	Steel	2	12	St. Louis (M. R. C.).
Cinque Hommes	90	81 0	18 0	3 3	Wood	1	4	Do.
Coal Bluff	230	128 0	25 0	4 6	...do	2	9	Rock Island.
Colbert	185	158 0	25 6	4 6	...do	1	9	Chattanooga.
Columbus	231	154 0	28 0	4 0	...do	3	24	Montgomery.
Control	232	157 0	26 6	4 8	...do	4	10	Vicksburg (M. R. C. 3d).
Coppee, H. St. L	350	166 0	30 0	6 0	Steel	8	18	Do.
Craighill, Gen	198	133 9	28 0	4 3	...do	2	5	Wheeling.
Cumberland	189	132 0	27 0	4 0	Wood	1	5	Nashville.
E. A. W	16	30 0	9 6	2 6	Steel	......	......	Cincinnati (1st).
Elinor	213	125 0	25 0	4 0	Wood	2	12	Rock Island.
Ellen	200	124 0	26 6	4 5	...do	1	7	Do.
Elsie	40	67 0	13 0	3 0	Steel	2	5	Do.
Emerald	28	77 2	12 0	3 3	Wood	1	3	Louisville.
Emily	25	67 0	12 0	3 0	...do	2	3	Rock Island.
Ewens, John	162	136 6	21 0	4 10	Steel	3	12	St. Louis (M. R. C.).
Fox	128	107 8	18 4	5 0	Wood	3	4	Milwaukee.
Fox	19	66 6	12 3	3 0	...do	2	3	Chicago.
Fury	110	113 0	22 0	3 10	...do	2	7	Rock Island.
Grace	38	79 0	17 0	3 11	...do	2	3	Do.
Graham	138	134 2	21 0	3 0	...do	3	7	Memphis (M. R. C. 1st and 2d).
Gregory	240	131 0	22 0	4 2	...do	2	6	Cincinnati (2d).
Gurney, Lt	191	136 0	25 6	5 0	Steel	2	7	Kansas City.
Guyandot	229	157 11	31 7	4 3	Steel and iron.	1	8	Cincinnati (1st).
Henry	34	87 0	18 8	3 2	Wood	1	4	Nashville.
Hider, Arthur	350	163 0	30 0	6 0	Steel	8	18	Vicksburg (M. R. C. 3d).
Hiwassee	104	100 0	19 0	3 6	Wood	1	5	Chattanooga.
Hyacinth	75	102 6	18 0	2 6	...do	2	6	New Orleans.
Iroquois	176.8	130 6	38 0	4 5	Steel	3	9	Cincinnati (1st).
Isle de Bois	50	70 0	18 0	3 3	Wood	1	4	St. Louis.
Issaquena	441	145 6	30 0	6 0	Steel	8	18	Vicksburg (M. R. C. 3d).
Itasca	80	94 0	15 0	5 0	Iron	2	2	Memphis (M. R. C. 1st and 2d).
Joachim	90	81 0	18 0	3 3	Wood	1	4	St. Louis.
John	34	87 0	18 8	3 2	...do	1	4	Nashville.
Jupiter	120	99 0	20 0	4 6	Steel	......	......	St. Louis (M. R. C.).
Kaskaskia	150	100 0	24 0	4 3	...do	1	4	Do.
Keith, George G	......	126 0	22 7	4 0	Wood	2	7	Kansas City, Mo.
King, Col. W. R	37	78 7	15 1	3 0	...do	1	4	Chattanooga.
King, Wm. R	716	190 0	41 0	5 0	Steel	6	26	St. Louis.
Lafourche	300	136 0	27 10	5 6	...do	3	9	New Orleans (M. R. C. 4th).
Leota	167	137 0	23 0	4 6	Wood	2	4	Montgomery.
Leota	560	171 6	36 0	5 6	Steel	2	12	St. Louis (M. R. C.).
Lewis, Lt	191	136 0	25 6	5 0	...do	2	7	Kansas City.
Loma	31	96 0	16 1	4 7	Wood	2	4	Wheeling.
Lookout	180	125 0	26 0	4 4	...do	1	7	Chattanooga.

Name, number, or letter.	Displacement.	Dimensions.						Material.	Complement.		District.
		Length.		Breadth.		Depth.			Officers.	Men.	
	Tons.	*Ft.*	*in.*	*Ft.*	*in.*	*Ft.*	*in.*				
Louise	25	61	0	12	0	3	2	Steel	2	3	Rock Island.
Lucia	25	68	0	12	8	3	0	Wood	1	4	Do.
Mac	35	73	0	16	0	3	3	...do	2	3	Do.
Marion	54	80	0	18	0	3	0	...do	2	4	Do.
Mars	83	80	0	17	0	3	9	Steel	1	6	St. Louis (M. R. C.).
McPherson	113	115	0	20	6	3	6	Wood	1	9	Chattanooga.
Mercury	83	80	0	17	0	3	9	Steel	1	6	St. Louis (M. R. C.).
Meramec	150	100	0	24	0	4	3	...do	1	4	Do.
Merrill	163	115	0	22	0	3	0	Wood	1	7	Cincinnati (2d).
Miami	229	157	11	31	7	4	3	Steel and iron.	1	8	Cincinnati (1st).
Minnetonka	490	204	2	29	6	5	4	Wood	4	13	Memphis (M. R. C. 1st and 2d).
Mississippi	540	174	0	32	0	6	0	Steel	4	36	St. Louis (M. R. C.).
Newton, Gen. J	560	175	0	24	0	7	6	...do	3	9	New Orleans (M. R. C. 4th).
Nokomis	560	171	6	36	0	5	6	...do	6	23	St. Louis (M. R. C.).
Nolty, Augustus J	150	136	0	24	0	5	0	...do	3	10	Memphis (M. R. C. 1st and 2d).
Nugent	191	141	3	24	6	4	3	Wood	3	10	Mobile.
Osage	39	68	8	15	1	3	2	...do	2	2	Kansas City.
Pearl	40	85	1	18	0	4	0	...do	2	4	Chicago.
Plaquemine	300	136	0	28	0	5	6	Steel	3	9	New Orleans (M. R. C. 4th).
Rees, W. M	150	136	0	24	0	5	0	...do	3	10	Memphis (M. R. C. 1st and 2d).
Roberts, T. P	206	133	2	22	10	5	0	Wood	2	7	Pittsburgh.
Ruth	40	75	0	17	0	2	3	...do	2	4	Rock Island.
Sachem	560	171	6	36	0	5	6	Steel	2	12	St. Louis (M. R. C.).
Salvisi	150	100	0	24	0	4	3	...do	1	4	Do.
Saturn	120	99	0	20	0	4	6	...do	......	......	St. Louis (M. R. C.).
Scioto	229	157	11	31	7	4	3	Steel and iron.	1	10	Cincinnati (1st).
Search	80	120	6	22	3	4	0	Wood	3	19	St. Louis (M. R. C.).
Shawnee	83	117	0	25	4	3	6	...do	2	5	Louisville.
Simpson, Gen. J. H	525	170	0	32	0	5	0	...do	6	23	St. Louis.
Slackwater	242	137	8	26	10	4	4	...do	2	21	Pittsburgh.
Teche	90	100	0	20	4	5	0	Steel	3	9	New Orleans (M. R. C. 4th).
Tensas	78	93	6	20	4	4	6	...do	2	5	Do.
Tom Ray	30	60	3	14	0	2	6	Wood	1	3	Nashville.
Vega	112	104	0	17	4	4	0	...do	1	7	Cincinnati (2d).
Venus	83	93	0	17	0	3	9	Steel	1	6	St. Louis (M. R. C.).
Vulcan	83	93	0	17	0	3	9	...do	1	6	Do.
Wave Rock	28	56	0	12	0	2	6	Wood	......	4	Louisville.
Wolf	114	89	0	19	0	4	6	...do	3	2	Milwaukee.
Wynoka	560	171	6	36	0	5	6	Steel	2	12	St. Louis (M. R. C.).

TABLE 13.—STEAM LIGHTERS.

Executive	236	86	3	20	0	8	5	Wood	1	3	Boston.
Panuco	287	107	0	28	0	8	6	...do	2	6	New London.

TABLE 14.—GASOLINE LAUNCHES (SCREW).

Name, number, or letter.	Displacement.	Dimensions.			Material.	Complement.		District.
		Length.	Breadth.	Depth.		Officers.	Men.	
	Tons.	*Ft. in.*	*Ft. in.*	*Ft. in.*				
Albatross	0.7	31 6	7 0	2 10	Wood			Pittsburgh.
Alberita		26 0	5 3	1 3	...do			Rock Island.
Amelia	5	35 0	8 0	3 6	...do			Savannah.
Amite	1.21	20 11	3 11	1 6	...do			New Orleans.
Ana		18 3	4 6	1 4	...do			Washington, D. C.
Arc	1	16 0	4 5	2 0	...do		1	Duluth.
Ariel	6	31 6	7 3	4 7	...do		1	Cleveland.
Arrow	2	31 0	7 0	4 0	...do		2	Montgomery.
Auxvasse	1	30 0	4 6	2 0	...do		1	Kansas City, Mo.
Bar	2	26 6	6 11	3 7	...do	1	1	Galveston.
Bass		26 0	5 3	1 3	...do			Rock Island.
Bastrop	16	46 6	11 6	5 0	...do	1	1	Galveston.
Beatrice		30 0	6 6	3 2	...do			New Orleans (M. R. C. 4th).
Beaumont	32	58 2	13 7	8 5	...do	1	2	Dallas.
Beetle		26 0	5 1	1 5	...do			Rock Island.
Bell		16 4	4 4	1 8	...do			Washington, D. C.
Bertha S	4.7	33 0	6 6	2 4	...do		1	Grand Rapids.
Biloxi	25	40 0	11 7	4 7	...do	2	1	Mobile.
Birch	1.5	28 0	6 6	2 6	Steel			St. Louis.
Bittern		26 0	5 3	1 3	...do			Rock Island.
Black Rock	1	25 0	7 3	4 3	...do		1	Buffalo.
Boeuf		14 6	4 5	2 8	Wood			New Orleans.
Bolivar	.9	25 0	5 0	1 11	...do	1	1	St. Louis (M. R. C.).
Bonne Femme		24 8	5 6	2 5	Steel			Kansas City.
Bull Calf	1	23 0	6 0	3 4	Wood		1	St. Paul.
Bully	1	20 7	6 0	2 8	...do	1	1	Galveston.
Burton No. 1	.9	18 2	4 2	2 3	...do			Cleveland.
Caddo	2.5	30 0	8 0	3 0	...do			Dallas.
Calumet	2	22 0	5 0	1 4	...do			Chicago.
Catoma	2	25 0	7 3	2 0	...do			Montgomery.
C. B. C	2	20 4	6 0	3 0	...do	1	1	Galveston.
Cerritos		36 6	9 6	4 9	...do		1	Los Angeles.
Charlton	1	24 0	5 0	1 10	...do		1	Kansas City, Mo.
Chica	.35	19 6	5 5	2 7	...do			Jacksonville.
Chico	.6	20 0	5 0	2 2	Steel			Cincinnati (1st).
Chicot	4.2	35 5	6 6	3 0	...do			Vicksburg (3d M. R. C.).
Chippewa		35 0	6 0	2 6	Wood		1	Rock Island.
Chord	2	22 6	5 5	2 7	...do		1	Duluth.
Clermont	.9	25 11	6 0	3 0	...do			Cincinnati (1st).
Clinch	3.3	35 0	8 0	3 9	...do		1	Chattanooga.
Clyde	9	42 0	9 3	2 7	...do			San Francisco (1st).
Cobra		26 0	5 3	1 3	...do			Rock Island.
Cockspur	1.4	20 0	6 0	2 9	...do			Savannah.
Colonel	31	66 8	12 6	5 6	...do	2	2	Galveston.
Columbia	2.2	31 7	6 0	1 11	...do		1	Charleston.
Comet		26 0	5 3	1 3	...do			Rock Island.
Commodore	1	23 4	6 0	3 2	...do			Galveston.
Coot	1.5	21 0	4 7	2 0	...do			Montgomery.
Coot		20 0	5 9	1 8	...do			Rock Island.
Corvi	2	18 0	4 10	2 4	...do		1	Jacksonville.
Cosine	4	25 0	6 6	2 6	...do			Savannah.
Coyote	2	28 0	5 6	3 0	...do			Portland, Oreg. (1st).
Crane		20 0	5 9	1 8	...do			Rock Island.
Curlew		20 0	5 9	1 8	...do			Do.
Curve	2	22 6	5 5	2 7	...do		1	Duluth.
D'Armit	4.3	35 0	8 3	4 6	...do			Jacksonville.
Dahlia		26 0	5 3	1 3	Steel		1	Cincinnati (1st).
Daisy		26 0	5 3	1 3	...do		1	Do.
Dakota	2	28 0	5 2	1 3	Wood			Rock Island.
Dauphin	58	80 4	17 1	4 6	...do	3	3	Mobile.
Davey		24 8	5 3	1 8	...do			Rock Island.
Dawho	25	60 0	13 0	8 0	...do	2	1	Charleston.
Delafield	8	39 6	9 6	6 6	...do		1	New York (1st).
Delaware	2	20 2	6 8	3 2	...do			Philadelphia.
De Soto	14	57 6	10 7	5 1	...do	2	3	Jacksonville.
Dolly	2.5	25 2	5 10	2 6	...do			Portland, Oreg. (2d).
Dolly		26 0	5 3	1 3	...do			Rock Island.
Dolphin	4	28 0	4 6	2 4	Steel		1	Do.
Don	9	41 9	9 7	3 6	Wood	1	1	Detroit.
Dorothy	1.5	22 2	6 11	1 4	...do			Philadelphia.

Name, number, or letter.	Displacement.	Dimensions.			Material.	Complement.		District.
		Length.	Breadth.	Depth.		Officers.	Men.	
	Tons.	Ft. in.	Ft. in.	Ft. in.				
Du Brie	1.9	28 6	5 0	3 8	Wood		1	Louisville.
Echo River	4	39 9	7 5	3 2	...do		1	Do.
Ellis	7.5	33 0	9 2	3 1	...do		1	New London.
Engineer	10	37 6	7 8	3 0	...do			Grand Rapids.
Engineer	4	30 0	6 6	2 8	...do		1	Washington Barracks, D. C.
Engineer, U. S	6.3	30 0	6 5	2 2	...do		1	Newport.
Enif	7	30 0	7 6	4 6	...do		1	Jacksonville.
Enquirer		30 4	7 0	3 0	...do			Kansas City.
Etowah	2	25 6	6 6	2 10	...do			Montgomery.
Eudora	1	20 0	5 0	1 6	Galvanized iron.		1	Nashville.
Eufaula	.8	27 6	7 3	2 4	Wood			Montgomery.
Eureka	1.8	30 2	7 8	3 2	...do		1	Dallas.
Eureka	3	25 0	8 6	3 3	...do			Portland, Oreg. (2d).
Faber	10	42 0	10 0	4 0	...do		3	Wilmington, N. C.
Firefly		26 0	5 1	1 5	...do			Rock Island.
Folly		26 0	5 3	1 3	...do			Do.
Fox		26 0	5 3	1 3	...do			Do.
Frances	7	43 0	7 10	3 0	...do		2	Wilmington, N. C.
Freak	2.5	27 0	8 0	3 0	...do		1	Jacksonville.
Fuchsia		26 0	5 3	1 3	Steel		1	Cincinnati (1st).
"G"	1.5	25 7	8 2	3 6	Wood	1	1	Galveston.
Galena		35 0	6 0	2 6	Steel		1	Cincinnati (1st).
Ganawanda	4	32 0	5 6	2 6	Wood		1	New York (1st).
Gannet	20	72 0	12 6	5 2	...do	1	3	Wilmington, Del.
Gar		26 0	5 3	1 3	...do			Rock Island.
Gazelle	73	66 5	18 2	10 7	...do	1	4	Newport.
Gladwin No. 1		20 0	4 7	2 3	...do	(1)	(1)	Detroit.
Gladwin No. 2		15 4	4 5	1 9	...do	(1)	(1)	Do.
Gnat		26 0	5 1	1 5	...do			Rock Island.
Grey Cloud	2	58 0	5 2	1 3	...do		1	Do.
Gull		20 0	5 9	1 8	...do			Do.
Hancock No. 1	1.5	15 6	4 6	2 0	...do			Detroit (Lake Survey).
Harpeth	1.75	26 0	6 0	2 2	Steel			Nashville.
Helen	33	56 0	12 4	5 9	Wood	1	1	Galveston.
Heron	11	36 0	9 6	4 5	...do		1	Milwaukee.
Hiawatha		35 0	6 0	2 6	...do			Rock Island.
Hill	6.9	31 5	7 7	2 6	...do	1	1	Galveston.
Hinda	1.8	28 0	7 6	4 3½	...do		2	Wilmington, Del.
Holly		26 0	5 3	1 3	...do			Rock Island.
Hornet		26 0	5 3	1 3	...do			Do.
Hydrog	1	24 10	5 7	1 6	...do			St. Louis (M. R. C.).
Ingalls, Gen	8	43 0	8 4	4 9	...do	2		New York (2d).
Ino	1	22 0	6 8	2 6	...do		1	Dallas.
Inspector	6	31 0	6 6	4 6	...do		1	Cleveland.
Inspector	26	50 3	8 9	4 8	Steel		2	Detroit (Lake Survey).
Jefferson	2	30 7	7 0	5 6	Wood			Dallas.
Jennie	5	30 0	8 0	3 2	...do			Portland, Oreg. (1st).
Jolly		26 0	5 3	1 3	...do			Rock Island.
Jordan	8.5	32 4	9 8	3 2	...do	1	1	Mobile.
Juanita	1	22 0	6 0	2 2	...do		1	Dallas.
Katherine	2	30 5	7 11	3 11	...do			New London.
Kingfisher	19	41 1	11 0	4 0	...do		2	Milwaukee.
Krey, John	7	35 5	8 0	5 0	...do			Wilmington, N. C.
Lad		23 0	6 6	2 0	...do			Detroit.
Lamine	.5	20 0	4 9	1 11	...do		1	Kansas City, Mo.
Lark		26 0	5 3	1 3	...do			Rock Island.
Laura	6	40 9	6 7	4 2	Steel		2	Louisville.
Leach, Col	5.32	36 4	10 6	4 3	Wood			Washington, D. C.
Leaf	4.5	32 0	7 6	4 0	...do	1	1	Mobile.
Liberty	2	26 0	7 0	2 10	...do		1	Dallas.
Little Blue	1	24 0	5 0	1 10	...do		1	Kansas City, Mo.
Locust		26 0	5 1	1 5	...do			Rock Island.
Long, J. C	12	42 0	8 5	3 7	Steel		2	Cincinnati (1st).
Long Point	5	38 0	9 6	4 0	Wood		2	Norfolk.
Lookout	3	30 0	6 6	3 9	...do			New York (super. of N. Y. Harbor).
Loon		26 0	6 0	1 6	...do			Rock Island.
Louise	13	40 0	10 0	5 0	...do		1	Charleston.
Ludington	1.47	22 4	5 0	2 4	...do		1	Grand Rapids.
Lunette	3	20 0	5 6	3 6	...do		1	Jacksonville.
Luzon	12	53 0	9 4	4 9	...do	1	1	Pittsburgh.
Mai	.95	18 0	5 10	2 5	...do		1	Jacksonville.
Mallard	8	35 0	9 0	4 2	...do		1	Milwaukee.
Madge	4	25 0	6 0	3 0	...do			Rock Island.
Maguire, Capt	49	67 0	17 7	4 2	...do	2	5	Jacksonville.

[1] Part of U. S. S. *Gladwin* outfit.

Name, number, or letter.	Displacement.	Dimensions.			Material.	Complement.		District.
		Length.	Breadth.	Depth.		Officers.	Men.	
	Tons.	*Ft. in.*	*Ft. in.*	*Ft. in.*				
Mamie K	2	25 0	6 0	2 7	Wood	1		Mobile.
Mansker	.5	20 0	5 0	2 0	...do		1	Nashville.
Margaretta	3	21 0	5 6	2 6	...do			Portland, Oreg. (1st).
Marie		29 0	8 0	4 0	...do			New York (1st).
M. C		16 0	4 0	1 10	...do			Chicago.
Meyler, Capt. J. J	44	70 6	15 0	7 8	...do	2	3	Jacksonville.
Mignon	.5	18 4	5 2	2 1	Steel			Cincinnati (1st).
Millville	1	22 6	6 6	2 6	Wood		1	Norfolk.
Minnehaha		35 0	6 0	2 6	...do			Rock Island.
Minneiska		35 0	6 0	2 6	...do		1	Do.
Mohawk	5.5	35 0	8 6	3 9	...do			Portland, Oreg. (2d).
Molly		26 0	5 3	1 3	...do			Rock Island.
Moniteau	1	24 0	5 0	1 10	...do		1	Kansas City, Mo.
Monomoy	65	82 9	15 6	9 6	...do	2	3	Newport.
Monroe	4	40 0	8 6	4 0	...do		2	Wheeling.
Moreau		20 0	5 1	2 1	Steel			Kansas City.
Mosquito		26 0	5 1	1 5	Wood			Rock Island.
Moth		26 0	5 1	1 5	...do			Do.
M. R. C–1		19 6	4 10	1 3	...do		1	St. Louis (M. R. C.).
M. R. C–2		19 6	4 10	1 3	...do			Do.
Mulberry	2.62	35 0	6 10	3 10	...do	1	1	Mobile.
Munden	1	22 6	6 6	2 6	...do		1	Norfolk.
Murrelet	2.5	24 0	6 5	5 6	...do			Portland, Oreg. (1st).
Muskrat	1	19 3	5 2	1 7½	...do		1	St. Paul.
Myra	10	40 0	7 4	3 6	...do			Rock Island.
Nancy	7.75	30 0	6 5	2 0	...do		2	Wilmington, N. C.
Nanina	5	42 4	7 5	3 11	...do		2	Wheeling.
Neches	1.1	26 0	6 0	2 4	Steel		1	Dallas.
Nell	1.5	25 0	5 6	2 3	Wood			Cincinnati (1st).
Nemadji	20	60 9	12 0	6 2	...do	2	1	Duluth.
Neptune	3.3	32 0	5 4	3 6	...do		1	New Orleans (4th M. R. C.).
New Castle	1.5	23 0	7 0	2 8	...do			Philadelphia.
Nola	8.5	35 0	7 6	4 6	...do		1	Honolulu.
Norka	22	62 0	14 0	6 1	...do	1	1	Portland, Me.
Norva	6.5	36 10	10 6	4 3	...do	2		Norfolk.
Obion	.9	25 0	5 0	1 11	...do	1	1	St. Louis (M. R. C.).
Ocia	2	30 0	5 0	3 0	...do			Portland, Oreg. (1st).
Olive	5	34 0	8 0	3 2	...do		1	Wilmington, N. C.
Ontario		27 0	6 3	4 0	...do		1	Buffalo.
Oostenaula	.2	25 0	6 0	3 2	...do			Montgomery.
Opelika	37	60 6	12 6	5 3	...do	2	1	Memphis (M. R. C. 1st and 2d).
Orcas	45	70 6	14 0	3 7	...do	2	2	Seattle.
Otter	2	28 0	5 2	1 3	...do		1	Rock Island.
Ouachita	17	65 6	10 5	4 0	Steel	2	2	Vicksburg.
Palouse	2	32 0	4 4	2 8	Wood			Portland, Oreg. (1st).
Pansy		26 0	5 3	1 3	...do		1	Rock Island.
Pathfinder	10	38 0	9 6	6 5	...do		2	Baltimore.
Papoose	6	30 3	8 0	4 0	...do			Portland, Oreg. (2d).
Paquippe	65	82 9	15 6	9 6	...do	2	3	Norfolk.
Pearl	5	40 0	7 6	4 0	...do		2	Cincinnati (2d).
Pedrito	2.2	30 0	7 0	3 4	...do		1	Los Angeles.
Peony		26 0	5 3	1 3	...do		1	Rock Island.
Pequot	2.5	28 3	7 4	4 6	...do		1	New London.
Perch		26 0	5 3	1 3	...do			Rock Island.
Phoenix, John	1.4	28 0	5 0	2 3	...do		1	Louisville.
Pink		26 0	5 3	1 3	...do		1	Rock Island.
Pioneer	6	35 0	8 6	4 0	...do		1	Cincinnati (2d).
Pipin	2	28 0	5 2	1 3	...do		1	Rock Island.
Plebe	19	56 0	9 0	5 0	...do	1	1	Boston.
Plover		20 0	5 9	1 8	...do			Rock Island.
Polly		26 0	5 3	1 3	Steel			Do.
Polly	2	16 0	4 6	2 6	...do		1	Wilmington, N. C.
Powhatan	6.4	40 2	9 9	4 3	...do			Norfolk.
Primary	1.3	18 5	5 0	2 0	Wood			Montgomery.
Pulaski	2	22 0	7 0	3 0	...do			Savannah.
Quincy		35 0	6 0	2 6	...do			Rock Island.
Racket	1	22 6	4 7	1 7	...do		1	Kansas City, Mo.
Relee	5.3	30 0	7 6	3 1	Steel			Washington, D. C.
Rio Vista	45.5	60 0	16 0	7 0	Wood		2	San Francisco (3d).
Robert J	1	24 0	4 6	2 0	...do		1	Wilmington, N. C.
Rock Island Rapids	4	22 0	4 0	2 0	Steel			Rock Island.
Rocks	5	26 0	7 3	4 0	Wood			Wilmington, N. C.
Rose		26 0	6 0	1 8	...do			Rock Island.
Salem	6.5	35 0	9 0	3 6	Steel	1		Portland, Oreg. (2d).
Sally		26 0	5 3	1 3	...do			Rock Island.
Salvador	13.8	41 0	9 6	4 0	...do			New Orleans.
Santa Rosa	64	70 0	16 0	8 0	...do	1	4	Montgomery.
Soojaquada	65	82 9	15 6	9 6	Wood	2	3	Buffalo.
Schuylkill	16	54 0	12 0	5 3	Steel	2	1	Philadelphia.

Name, number, or letter.	Displacement.	Dimensions.			Material.	Complement.		District.
		Length.	Breadth.	Depth.		Officers.	Men.	
	Tons.	*Ft. in.*	*Ft. in.*	*Ft. in.*				
Schuyler	1.2	25 0	5 8	1 10	Steel	......	......	New York (2d).
Scorpion	1.5	23 0	7 0	4 0	...do	......	......	Philadelphia.
Scorpion	....	28 0	4 6	2 4	Wood	......	1	Rock Island.
Seminole	8	36 4	10 6	5 10	...do	......	1	Chicago.
Seneca	7.3	40 0	8 0	2 9	...do	......	......	Savannah.
Sergeant Burke	5	35 0	8 6	3 6	...do	......	1	Wheeling.
Sextant	2	27 0	6 0	4 0	Steel	......	1	Dallas.
Shad	....	26 0	5 3	1 3	...do	......	......	Rock Island.
Shearwater	4	40 0	8 0	6 0	Wood	......	4	Montgomery.
Sioux	1	24 0	5 0	1 10	...do	......	1	Kansas City, Mo.
Sisters, The	.5	25 0	4 4	3 0	...do	......	......	Cincinnati (1st).
Snapshot	1	18 0	6 0	3 6	...do	1	1	Galveston.
Sirius	5	32 0	8 0	3 0	...do	......	1	Jacksonville.
Snipe	....	20 0	6 4	2 0	...do	......	......	Rock Island.
Sparrow	....	20 0	5 10	1 7	...do	......	......	Do.
Spray	12.5	45 6	11 0	7 6	...do	......	......	Savannah.
Spry	1	20 0	6 0	3 6	...do	1	1	Galveston.
Spry	2	18 6	5 4	3 8	...do	......	1	Wilmington, N. C.
Stadia	5	30 3	6 5	2 9	...do	......	......	New Orleans.
Starvation	1	22 6	6 6	2 6	...do	......	1	Norfolk.
Stewart	1.5	28 0	6 6	2 6	Steel	......	......	St. Louis.
Sulphur	2.5	30 0	8 0	3 0	Wood	......	1	Dallas.
Swallow	....	20 0	5 10	1 7	...do	......	......	Rock Island.
Swift	....	20 0	5 10	1 7	...do	......	......	Do.
Tarpon	2	28 6	7 0	3 1	...do	1	1	Galveston.
Thom, Gen. Geo	24	73 0	12 5	4 6	...do	......	......	Wilmington.
Tilly	....	26 0	5 3	1 3	...do	......	......	Rock Island.
Tocoi	.24	16 10	4 1	1 9	Steel	......	......	Jacksonville.
Trenton	4.5	28 0	8 0	3 8	Wood	......	......	Philadelphia.
Trimbelle	....	35 0	6 0	2 6	...do	......	1	Wilmington, N. C.
Trout	....	26 0	5 3	1 3	...do	......	......	Rock Island.
Vamos	5	31 0	7 0	2 2	...do	......	......	Do.
Vermilion	1.75	20 1	4 11	2 4	...do	......	......	New Orleans.
Vernon	1	15 0	4 0	2 3	...do	......	......	Montgomery.
Victoria	3	27 0	7 0	3 4	...do	1	1	Galveston.
Vigilant	22	63 5	12 0	7 6	...do	1	1	Portland, Oreg. (2d).
Violet	....	26 0	5 3	1 3	...do	......	1	Wilmington, N. C.
Violetta	8	31 0	11 4	4 4	...do	......	1	Jacksonville.
Viper	....	28 0	4 6	2 6	...do	......	......	Rock Island.
"W"	....	16 4	4 8	0 10	...do	......	......	New York (1st).
Wacouta	2	26 0	5 3	1 3	...do	......	1	Rock Island.
Wah-ta-wah	36	80 0	15 0	5 2	...do	2	2	New York (1st).
Wakenda	1	24 0	5 0	1 10	...do	......	1	Kansas City, Mo.
Waumandee	....	30 6	5 9	3 0	...do	......	1	Wilmington, N. C.
Wasp	....	22 0	5 0	0 8	...do	......	......	Rock Island.
Wekiva	.5	18 0	5 6	2 1	...do	......	1	Jacksonville.
Welaka	.5	20 0	5 6	2 2	...do	......	1	Do.
Wild Horse	1	24 0	5 0	1 10	...do	......	1	Kansas City, Mo.
Wolf	18	36 8	10 0	3 6	...do	1	1	Mobile.
Wren	....	26 0	5 3	1 3	...do	......	......	Rock Island.
Yawl	....	26 0	5 3	1 3	...do	......	......	Do.
Zumbro	....	35 0	6 0	2 6	...do	......	1	Wilmington, N. C.
No. 1	1	25 0	5 6	4 0	...do	......	......	Detroit.
No. 1	....	14 0	4 0	2 6	...do	......	......	Wilmington, Del.
No. 1, Inspector	3	25 0	4 6	2 6	Steel	......	......	Little Rock.
No. 2	2	20 0	5 3	3 0	...do	......	1	Chattanooga.
No. 3	3	22 0	6 3	3 2	Wood	......	1	Do.
No. 3, U. S. L. S	2.6	22 3	6 3	3 2	...do	......	......	Detroit (Lake Survey).
No. 4	6	23 0	6 6	3 6	...do	......	1	Chattanooga.
No. 4, M. R. C	.81	20 0	4 10	1 3	...do	......	1	St. Louis (M. R. C.).
No. 4, U. S. L. S	10	38 6	4 6	4 2	...do	......	......	Detroit (Lake Survey).
No. 5	....	19 2	4 3	2 7	...do	......	......	Chattanooga.
No. 5, U. S. L. S	10	36 1	9 0	4 0	...do	......	......	Detroit (Lake Survey).
No. 6	4	23 0	6 0	4 6	...do	......	1	Chattanooga.
No. 6, U. S. L. S	10	36 0	9 0	4 0	...do	......	......	Detroit (Lake Survey).
No. 7	3	27 6	4 0	3 8	...do	......	1	Chattanooga.
No. 8, U. S. L. S	2.4	23 3	6 6	3 3	...do	......	......	Detroit (Lake Survey).
No. 26	90	80 0	37 0	4 0	...do	......	......	Mobile.
No. 32	....	28 0	4 6	2 4	...do	......	......	Rock Island.
No. 33, U. S. E. D., Wheeling.	.67	22 0	5 10	1 10	...do	......	......	Wheeling.
No. 34, U. S. E. D., Wheeling.	.67	22 0	5 10	1 10	...do	......	......	Do.
No name	....	28 0	6 6	3 0	Steel	......	......	St. Louis.
No name	....	28 0	6 6	3 0	...do	......	......	Do.

TABLE 15.—GASOLINE TOWBOATS (PADDLE).

Name, number, or letter.	Displacement.	Dimensions.			Material.	Complement.		District.
		Length.	Breadth.	Depth.		Officers.	Men.	
	Tons.	*Ft. in.*	*Ft. in.*	*Ft. in.*				
Comet	21	69 0	16 0	2 4	Wood	......	2	Cincinnati (1st).
Coosa	123	95 0	18 0	4 9	...do	......	6	Montgomery.
Gasconade	13	59 2	12 6	2 6	...do	......	3	Kansas City.
Glenville	30	53 6	9 0	3 0	Steel	......	......	Wheeling.
Katherine	55	86 4	22 0	3 0	Wood	2	14	Kansas City.
Leona	10	46 0	10 0	3 0	...do	......	2	Rock Island.
Niota	25	70 0	13 9	3 0	...do	......	3	Chattanooga.
Richland	78.7	103 6	20 6	4 7	...do	......	......	Charleston, S. C.
Sylph	38	84 6	16 5	2 9	...do	1	2	Mobile.
White Oak	75	104 0	18 0	3 6	...do	......	7	Chattanooga.
No. 1	52	96 0	15 0	2 8	...do	......	2	Nashville.

TABLE 16.—QUARTER BOATS.

A	40	72 0	20 0	2 6	Wood	3	......	Kansas City.
A	34	45 0	24 0	5 0	...do	6	28	Mobile.
B	46	72 0	20 0	2 6	...do	......	20	Kansas City.
B	33	60 0	20 0	3 4	...do	3	21	Mobile.
Baton Rouge	198	140 0	30 4	4 0	...do	10	180	New Orleans (M. R. C. 4th).
Bayou Goula	198	140 0	30 4	4 0	...do	10	180	Do.
Bayou Sara	198	140 0	30 4	4 0	...do	10	180	Do.
Beaufort	15	50 0	18 3	2 8	...do	......	11	Wilmington, N. C.
Chester	90	60 0	25 0	5 8	...do	3	15	Philadelphia.
Coinjock	72.7	80 0	22 0	4 3	...do	5	21	Norfolk.
C-1	37	70 0	20 0	3 7	...do	......	28	Grand Rapids.
No. 2	30	65 0	14 0	2 6	...do	......	10	Nashville.
No. 3	16	60 0	14 0	2 6	...do	......	12	Do.
D	83	75 0	25 0	5 9	...do	5	20	Mobile.
Hay Lake	106	70 0	22 0	4 4	...do	......	......	Detroit.
Intercoastal	....	65 6	22 6	4 5	...do	......	......	New Orleans.
Lake Borgne	68	80 0	22 0	4 4	...do	3	16	New Orleans (M. R. C. 4th).
Margaret	30	100 0	26 0	4 3	...do	......	......	Chicago.
N	65	75 6	22 6	5 2	...do	......	21	Mobile.
Natchez	198	140 0	30 0	4 0	...do	10	180	New Orleans (M. R. C. 4th).
New Orleans	237	166 0	30 0	4 3	...do	10	180	New Orleans.
O	65	75 6	22 6	5 2	...do	......	20	Mobile.
Observer	25	50 0	20 0	5 0	...do	......	1	Philadelphia.
Olga	68	80 0	22 0	4 4	...do	4	8	New Orleans (M. R. C. 4th).
Port Arthur	84	60 0	28 0	6 0	...do	......	36	Dallas.
Port Hudson	68	80 0	22 0	4 4	...do	2	6	New Orleans (M. R. C. 4th).
Pungo	72.7	80 0	22 0	4 3	...do	5	21	Norfolk.
Skidaway	27	51 6	11 0	4 0	...do	......	......	Savannah.
St. Joseph	198	140 0	30 4	4 0	...do	10	180	New Orleans (M. R. C. 4th).
Sunshine	12	47 6	11 6	3 0	...do	......	8	Wilmington, N. C.
Thronateeska	96	75 0	26 0	4 7	...do	......	24	Montgomery.
Torros	68	80 0	22 0	4 4	...do	2	6	New Orleans (M. R. C. 4th).
Z	72	90 0	20 0	4 0	...do	4	36	Kansas City, Mo.
No. 1	27	40 8	14 3	5 0	...do	......	......	New Orleans.
No. 1	64	80 2	19 1	4 2	...do	......	11	Norfolk.
No. 1	28	65 0	14 0	2 6	...do	......	10	Nashville.
No. 1	20	60 0	16 0	3 0	...do	......	4	Chattanooga.
No. 1	80	60 8	23 7	7 6	...do	......	42	Galveston.
No. 1	110	100 0	20 0	5 0	...do	10	52	Kansas City.
No. 1	104	100 0	20 0	4 0	...do	......	69	Little Rock.
No. 1	23	50 0	20 0	3 7	...do	......	27	Montgomery.

Name, number, or letter.	Displacement.	Dimensions.			Material.	Complement.		District.
		Length.	Breadth.	Depth.		Officers.	Men.	
	Tons.	*Ft. in.*	*Ft. in.*	*Ft. in.*				
No. 1	44	85 0	22 0	3 6	Wood			Pittsburgh.
No. 1	120	90 0	26 0	4 0	...do		11	Portland, Oreg. (2d).
No. 1	130	135 0	30 0	3 11	...do	17	116	St. Louis.
No. 1, eches River	27	60 0	16 0	4 0	...do		10	Dallas.
No. 1, Trinity River	24	60 0	22 0	3 0	...do		36	Do.
No. 2	5	26 6	10 0	2 8	...do		8	Charleston.
No. 2	40	85 0	18 0	8 0	...do		48	Chattanooga.
No. 2	110	100 0	20 0	5 0	...do	10	52	Kansas City.
No. 2	25	70 0	18 3	3 6	...do		18	Milwaukee.
No. 2	23	50 0	20 0	3 7	...do		27	Montgomery.
No. 2	29.8	76 0	16 0	3 0	...do			Pittsburgh.
No. 2	130	135 0	30 0	3 11	...do	17	116	St. Louis.
No. 2	36	48 0	16 0	3 6	...do			St. Paul.
No. 2	34	68 0	18 0	3 0	...do	1	20	Vicksburg.
No. 2, Cypress Bayou.	35	66 6	22 0	3 6	...do		40	Dallas.
No. 2, Ohio	138	125 6	30 0	4 6	...do		44	Louisville.
No. 2, Ohio	88	110 0	22 0	3 6	...do		44	Do.
No. 3	2	22 0	8 4	1 9	...do		9	Charleston.
No. 3	24	65 0	16 0	8 0	...do		2	Chattanooga.
No. 3	11	50 0	16 0	3 0	...do			Chicago.
No. 3	110	100 0	20 0	5 0	...do	10	52	Kansas City.
No. 3	88	110 0	22 0	3 6	...do		52	Louisville.
No. 3	26	60 0	16 0	2 0	...do		8	Montgomery.
No. 3	115	135 0	26 0	3 6	...do	17	116	St. Louis.
No. 3	39	52 0	16 0	3 5	...do			St. Paul.
No. 3	34	68 0	18 0	3 0	...do	1	20	Vicksburg.
No, 3, Hudson River.	17	40 5	15 6	2 4	...do	3	9	New York (1st).
No. 3, Red River	25	62 0	18 0	2 10	...do	1	18	Dallas.
No. 3, Wabash	53	102 4	22 0	3 0	...do		16	St. Louis (M. R. C.).
No. 4	72	90 0	20 0	5 0	...do	1	41	Kansas City, Mo.
No. 4	15	51 0	13 0	4 0	...do			Savannah.
No. 4	16	53 0	16 0	2 9	...do		11	Wilmington, N. C.
No. 4	88	110 0	22 0	3 6	...do		16	Louisville.
No. 4	48	70 0	21 6	3 0	...do		50	Montgomery.
No. 4	115	135 0	26 0	3 6	...do	17	116	St. Louis (M. R. C.).
No. 4, Trinity River	35	66 6	22 0	3 6	...do		40	Dallas.
No. 5	25	64 0	16 0	3 0	...do		15	Chattanooga.
No. 5	20	41 0	16 0	3 10	...do			Savannah.
No. 5	72	90 0	20 0	5 0	...do	1	41	Kansas City, Mo.
No. 5	115	135 0	26 0	3 6	...do	17	116	St. Louis (M. R. C.).
No. 5	34	68 3	18 0	3 5	...do	1	20	Vicksburg.
No. 5, Ohio	169	124 6	25 0	4 2	...do		5	Louisville.
No. 5, Trinity River	6.5	30 0	16 0	2 9	...do		10	Dallas.
No. 6	20	65 0	16 0	3 0	...do		24	Chattanooga.
No. 6	84	100 0	20 0	5 0	...do	10	58	Kansas City, Mo.
No. 6	130	135 0	30 0	3 11	...do	17	116	St. Louis.
No. 6, Trinity River	6.5	30 0	16 0	2 9	...do		10	Dallas.
No. 7	44	106 0	21 0	3 0	...do		6	Chattanooga.
No. 7	84	100 0	20 0	5 0	...do	10	58	Kansas City, Mo.
No. 7	130	135 0	30 0	3 11	...do	17	116	St. Louis.
No. 7, Trinity River	6.5	30 0	16 0	2 9	...do		10	Dallas.
No. 8	27	67 0	16 0	3 0	...do		4	Chattanooga.
No. 8	84	100 0	20 0	5 0	...do	10	58	Kansas City, Mo.
No. 8	125	135 0	25 0	8 0	...do			Memphis (M. R. C. 1st and 2d).
No. 8	130	135 0	30 0	3 11	...do	17	116	St. Louis.
No. 8, Hudson River.	225	90 0	29 0	9 0	...do	18	90	New York (1st).
No. 8, Trinity River	6.5	30 0	16 0	2 9	...do			Dallas.
No. 9	56	104 0	20 0	3 6	...do		15	Chattanooga.
No. 9	130	135 0	30 0	3 11	...do	17	116	St. Louis.
No. 9	34	68 0	18 0	4 0	...do	1	20	Vicksburg.
No. 10	45	105 0	21 0	3 9	...do		36	Chattanooga.
No. 10	22	75 0	14 0	1 9	...do			Cincinnati (2d).
No. 10	130	135 0	30 0	3 11	...do	17	116	St. Louis.
No. 10	34	68 0	18 0	3 0	...do	1	20	Vicksburg.
No. 11	56	100 0	20 0	4 0	...do		3	Chattanooga.
No. 11	40	90 0	18 0	3 6	...do			Cincinnati (2d).
No. 11	125	135 0	25 0	8 0	...do		128	Memphis (M. R. C. 1st and 2d).
No. 11	46	75 0	20 0	3 0	...do		30	Rock Island.
No. 11	34	68 0	18 0	3 0	...do	1	20	Vicksburg.
No. 12	43	80 0	20 0	4 0	...do			Chattanooga.
No. 12	25	78 0	11 0	4 0	...do			Cincinnati (2d).
No. 12	125	135 0	25 0	8 0	...do			Memphis (M. R. C. 1st and 2d).
No. 14	55	100 0	24 0	4 0	...do		15	Chattanooga.
No. 14	35	70 0	16 0	4 0	...do		30	Rock Island.
No. 15	56	100 0	20 0	3 3	...do		25	Chattanooga.
No. 17	52	70 0	24 0	3 0	...do		84	Rock Island

Name, number, or letter.	Displacement.	Dimensions.						Material.	Complement.		District.
		Length.		Breadth.		Depth.			Officers.	Men.	
	Tons.	*Ft.*	*in.*	*Ft.*	*in.*	*Ft.*	*in.*				
No. 17 (office)	89	85	0	23	0	3	0	Wood	......	......	Vicksburg (M. R. C. 3d).
No. 10	113	100	0	24	0	4	0	...do	......	......	Chattanooga.
No. 20	93	100	0	24	0	4	0	...do	......	......	Do.
No. 21	93	100	0	24	0	4	0	...do	......	......	Do.
No. 25	125	135	0	25	0	8	0	...do	3	60	Memphis (M. R. C. 1st and 2d).
No. 25	120	80	0	20	0	5	0	...do	......	28	Montgomery.
No. 26	125	135	0	25	0	8	0	...do	......	......	Memphis (M. R. C. 1st and 2d).
No. 27	43	90	6	18	6	3	0	...do	......	2	Do.
No. 28	30	65	0	20	0	3	9	...do	......	......	Wheeling.
No. 29, Amelia	43	90	6	18	6	3	0	...do	11	2	Memphis (M. R. C. 1st and 2d).
No. 44	40	50	0	22	0	3	6	Steel	......	......	Cincinnati (2d).
No. 45	32	74	0	16	0	3	0	Wood	......	12	Rock Island.
No. 47	46	75	0	20	0	3	0	...do	......	35	Do.
No. 52 (office)	32	58	0	18	0	3	6	...do	......	18	Do.
No. 65	20	40	0	16	0	2	0	...do	......	6	Do.
No. 71	46	75	0	20	0	3	6	...do	......	6	Do.
No. 75	46	75	0	20	0	3	6	...do	......	35	Do.
No. 86	87	100	0	28	0	5	0	...do	3	......	Vicksburg (M. R. C. 3d).
No. 87	87	100	0	28	0	5	0	...do	8	80	Do.
No. 88	107	120	0	28	0	6	0	...do	......	12	Do.
No. 91	15	50	0	12	0	3	0	...do	......	12	Rock Island.
No. 92	40	81	0	16	0	3	0	...do	......	20	Do.
No. 118	43	70	0	20	0	3	0	...do	......	48	Do.
No. 120	14	40	0	14	0	2	0	...do	......	3	Do.
No. 121	26	52	0	16	0	2	6	...do	......	12	Do.
No. 122	26	52	0	16	0	2	6	...do	......	12	Do.
No. 123	26	52	0	16	0	2	6	...do	......	12	Do.
No. 131	186	131	0	30	0	5	0	...do	......	131	Vicksburg (M. R. C. 3d).
No. 155	107	120	0	28	0	6	0	...do	8	90	Do.
No. 156	107	120	0	28	0	6	0	...do	......	12	Do.
No. 157	107	120	0	28	0	6	0	...do	8	94	Do.
No. 158 (store)	107	120	0	28	0	6	0	...do	......	......	Do.
No. 159	107	120	0	28	0	6	0	...do	......	......	Do.
No. 183	62	100	0	20	0	3	0	...do	......	56	Rock Island.
No. 184	33	60	0	18	0	3	0	...do	......	18	Do.
No. 202	43	70	0	20	0	3	0	...do	......	35	Do.
No. 206	130	120	0	30	0	6	0	...do	......	120	Memphis (M. R. C. 1st and 2d).
No. 221	130	120	0	30	0	6	0	...do	......	120	Do.
No. 231	62	100	0	20	0	4	3	...do	......	56	Rock Island.
No. 232	62	100	0	20	0	4	3	...do	......	20	Do.
No. 237	46	68	0	22	0	3	0	...do	......	24	Do.
No. 262	45	66	0	22	0	3	0	...do	......	18	Do.
No. 301	46	75	0	20	0	4	0	...do	......	35	Do.
No. 342	50	80	0	20	0	3	0	...do	......	20	Do.
No. 343	43	70	0	20	0	3	0	...do	......	46	Do.
No. 344	43	70	0	20	0	3	0	...do	......	30	Do.
No. 345	43	70	0	20	0	3	0	...do	......	30	Do.
No. 316	50	80	0	20	0	3	0	...do	......	20	Do.
No. 347	50	80	0	20	0	3	0	...do	......	20	Do.
No. 348	50	80	0	20	0	3	0	...do	......	20	Do.
No. 367	50	78	0	26	0	3	0	...do	......	60	Do.
No. 411	60	76	0	26	0	4	0	...do	......	50	Do.
No. 412	51	82	0	20	0	3	0	...do	......	46	Do.
No. 414	43	70	0	20	0	3	0	...do	......	30	Do.
No. 492	50	71	0	18	0	3	6	...do	......	30	Do.
No. 504	40	75	0	20	0	3	0	...do	......	30	Do.
No. 505	40	75	0	20	0	3	0	...do	......	30	Do.
No. 512	42	80	0	18	0	3	6	...do	......	20	Do.
No. 513	42	80	0	18	0	3	6	...do	......	20	Do.
No. 514	42	80	0	18	0	3	6	...do	......	20	Do.
No. 0601	30	68	0	18	0	4	0	...do	5	14	Memphis (M. R. C. 1st and 2d).
No. 1010	177	135	0	34	0	5	0	...do	8	127	Vicksburg (M. R. C. 3d).
No. 1020	156	140	0	30	0	4	0	...do	......	156	Memphis (M. R. C. 1st and 2d).
No. 1021	156	140	0	30	0	4	0	...do	......	156	Do.
No. 1107	177	140	0	34	0	5	0	...do	......	129	Vicksburg (M. R. C. 3d).
No. 1108	177	140	0	34	0	5	0	...do	......	129	Do.
No. 1201	177	140	0	34	0	5	0	...do	......	129	Do.
No. 1202	177	140	0	34	0	5	0	...do	......	129	Do.

Name, number, or letter.	Displacement.	Dimensions.			Material.	Complement.		District.
		Length.	Breadth.	Depth.		Officers.	Men.	
	Tons.	*Ft. in.*	*Ft. in.*	*Ft. in.*				
No. 1301	77	100 0	26 0	4 0	Wood	3	33	Memphis (M. R. C. 1st and 2d).
No. 1307	177	140 0	34 0	5 0	...do	10	144	Vicksburg (M. R. C 3d).
No. 1308	177	110 0	34 0	5 0	...do	10	144	Do.
No. 1402	190	160 0	36 6	4 0	...do	2	255	Memphis (M. R. C. 1st and 2d).
U. S. E. D., Hudson River, No. 1.	30	42 0	20 6	3 2	...do	3	20	New York (1st).
U. S. E. D., Hudson River, No. 41.	129	86 9	26 4	8 9	...do	9	36	Do.
U. S. E. D., Hudson River, No. 44.	80	62 0	22 0	4 3	...do	2	33	Do.

TABLE 17.—CONCRETE MIXING PLANTS.

No. 7, Hudson River.	244	85 0	28 0	9 4	Wood	1	15	New York (1st).
No. 13, Hudson River	100	80 0	26 0	3 8	...do	2	13	Do.
No. 17, Hudson River	150	90 0	27 0	7 0	...do	6	9	Do.
No. 18, Hudson River	150	84 0	27 6	8 6	...do	6	7	Do.

PART V.

THE PANAMA CANAL REPORTS.

COMMISSIONS.

SECTION A.—LIST OF THE ISTHMIAN CANAL COMMISSIONS, COMBINED WITH A BRIEF TABLE OR SUMMARY OF THE MORE IMPORTANT TOPICS OF THEIR REPORTS, ARRANGED CHRONOLOGICALLY.

SUBJECTS.

SECTION B.—ALPHABETICAL ARRANGEMENT OF THE PRINCIPAL TOPICS OF THE REPORTS.

PLATES.

THE PANAMA CANAL.
ORGANIZATION CHARTS, 1907, 1909, 1914.

GUIDE TO THE USE OF PART V.

What is contained in this part.—An index in a brief form to the important engineering matter, etc., connected with the engineering project of constructing a waterway across the Central American Isthmus, from 1492 to 1914.

What engineering reports are indexed.—These are as follows:

1. Isthmian Canal Commission No. 1, 1899–1901, 1 volume and plates.
2. Isthmian Canal Commission No. 2, 1904, 1 volume.
3. Isthmian Canal Commission No. 3, 1905–1906, 2 volumes.
4. Board of Consulting Engineers, 1906, 1 volume and plates.
5. Isthmian Canal Commission No. 4, 1907–1913, 7 volumes and 4 sets of plates.
6. The Panama Canal (Isthmian Canal Commission and), 1914, 1 volume and plates.

The subjects of these reports.—On the pages immediately following this there is a list of the more important subjects of these reports so arranged that a brief inspection or examination of the list of subjects affords a general understanding of what has been involved in the work of constructing an artificial waterway across the Central American Isthmus.

This list of subjects is arranged chronologically. It shows also the personnel of the various commissions, and names important heads of departments. Reference is made to the paging of the reports on each subject in such a way that their length or scope is indicated. The list of subjects is arranged also to show something of the various plans of organization leading up to the completion of The Panama Canal.

Alphabetical arrangement.—With the exception of the matter referred to in the preceding paragraph, all the matter of Part V is arranged in the customary alphabetical form. Illustration: Details concerning appropriations will be found referred to under "Appropriations"; concerning dams, under "Dams"; and concerning terminals, under "Terminals."

Page references.—These are of the same character as in other parts of this index, with the exception of the addition of the letter P, which refers to the special reports on the Isthmian or Panama Canal project. Illustration: **P-06,** 436, pl. 5, means the report of the Isthmian Canal Commission for 1906, page 436, plate 5.

To distinguish the report of the Board of Consulting Engineers of 1906 from the other reports for that year, a star (*) is added to a reference to that report. Illustration: **P-06***, 377, means the report of the Board of Consulting Engineers, 1906, page 377.

Abstracts.—Brief abstracts have been provided of important reports. Illustration: Under "Projects" are brief but informative details concerning projects for waterways across the Isthmus. Under "Appropriations" is a table of appropriations for the work. Under "Atlantic Division" is a brief outline of the operations on that division.

Cross references.—Copious cross references have been provided. Illustration: "Dams" refers to "Locks," "Gates," etc., and to related subjects in the list of important subjects in Section A.

Names of places.—But few names of places have been listed alphabetically, because Part V is intended mainly to index engineering matter. Illustration: Under "Dams" have been collected the more important engineering facts connected with dams, rather than under "Gatun," "Miraflores," "Pedro Miguel," or "Bohio." There are subheads under "Dams" referring to each of these places, however, and each important reference usually names the place connected with the engineering fact indexed. This plan brings related engineering facts under one head usually, rather than under several scattered headings, and makes Part V more compact than would otherwise be the case.

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THE PANAMA CANAL REPORTS.

SECTION A—COMMISSIONS.

Table of subjects in the reports indexed in Part V.

1899–1901.

No.	Pages of this Index.	Reports.	1899–1901
			Paging of the Isthmian reports.
1	2484	**Isthmian Canal Commission (No. 1)**[1]	1–688
2	2549	Canal projects—1492–1901	18–43
3	2557	Dimensions and prices	44–48
4	2407	Routes	49–55
5	2408	Panama route	56–70
6	2408	Nicaragua route	71–111
7	2406	Earthquakes, climate, health, etc	112–114
8	2554	Rights and franchises	115–160
9	2427	Value of possible canal	161–166
10	2453	Military value of possible canal	167–168
11	2526	Upkeep, etc	169–170
12	2564	Conclusions of I. C. C. No. 1 (Nicaragua route favored)	171–175
13	2557, 2565	Locks	179–196
14	2556	History, Panama Canal Co., 1880–1894	197–214
15	2556	Documents, New Panama Canal Co	215–218
16	2407	Hydrography, Panama route	219–246
17	2406	Waste weirs and discharges, Bohio Lake	247–252
18	2559	Alternate line, Gatun-Bohio. (See Surveys, p. 2598 of this Index)	253–254
19	2609	Time of transit, by proposed routes	255–272
20	2406	Discharge, canalized San Juan R	273–280
21	2406	Hydrography, Nicaragua	281–348
22	2408	Surveys, San Juan R.-Indio R	349–352
23	2610	Treaties, contracts, etc	353–509
24	2427	Industrial and commercial value of canal	515–671
25	2563	Supplementary **R.**[2]—Comparison of Panama and Nicaragua routes. Sale of Panama rights proposed by French company. Panama route recommended, where previously Nicaragua route had been the choice	673–681

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[1] **Members:** Rear Admiral J. G. Walker, U. S. N., president; Samuel Pasco; Alfred Noble; George S. Morison; Col. Peter C. Hains, Corps of Engineers, U. S. A.; Wm. H. Burr; Lt. Col. O. H. Ernst, Corps of Engineers, U. S. A.; Lewis M. Haupt; and Emory R. Johnson. **R.** dated Nov. 16, 1901. Transmitted to President Roosevelt by Secretary of State John Hay, Nov. 30, 1901, and by President to Congress on Dec. 4, 1901. Au. act Mar. 3, 1899. Admiral Walker appointed June 10, 1899.

[2] S. Doc. 123, 57th Cong., 1st sess.

Table of subjects in the reports indexed in Part V.

1904.

No.	Pages of this Index.	Reports.	1904
			Paging of the reports.
26	2485	**Isthmian Canal Commission (No. 2)** [1]	1–95
27	2450	Customs, etc.	17–22
28	2594	Act authorizing canal construction	23–25
29	2610	Treaty with Panama (Republic)	25–31
30	2619	Laws establishing government	31, 65–70
31	2486	Instructions from the President	31–35
32	2619	Transfer of property to U. S	35–36
33	2485	Organization	36–38, 43–44
34	2485	Visit of Isthmian Canal Commission No. 2 to Isthmus	38–40
35	2481	Harbor, Cristobal	40
36	2599	Proposed dam at Gatun, or Tiger Hill	41
37	2599	Bohio Dam	41–42
38	2583	Control of Chagres	42–43
39	2617	Waterworks and sewers, Panama and Colon	44–48
40	2461	Engineering and construction [2]	48–49
41	2585	Sanitation	49–53
42	2369	Accounting system	53–54
43	2508	Material, supplies, and machines	54–57
44	2542	Panama R. R	57–65
45	2493	Municipalities and legislation	68–70
46	2471	Expenditures and estimates	71–74
47	2369	Treasurer's **R.**	75–76
48	2619	Governor of Zone [3]	77–95
49	2619	Transfer of Zone [2]	78–79
50	2619	Geography	79–80
51	2480	Harbors	80–81
52	2524	Municipalities	81–82
53	2619	Industrial and social conditions	82
54	2619	Zone government	82–83
55	2619	Postal affairs	83–84
56	2619	Public order	84–85
57	2619	Justice and judiciary	85–86
58	2619	Jails	86
59	2585	Health and sanitation	86–91
60	2619	Lands and buildings	91–93
61	2619	Public works	93–94
62	2619	Telegraphs and telephones	94
63	2581	Receipts and disbursements	94–95

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[1] Members: Rear Admiral J. G. Walker, U. S. N., chairman; Maj. Gen. Geo. W. Davis, U. S. A.; Wm. B. Parsons; W. H. Burr; B. M. Harrod; C. E. Grunsky; and F. J. Hecker. Commission au. act June 28, 1902. **R.** for period, May, 1904, the date of creation of I. C. C. No. 2, to Nov. 30, 1904.

[2] Head of engineering staff immediately after transfer from the French company (New Panama Canal Company), Maj. W. M. Black, Corps of Engineers, U. S. A. Maj. Black (Chief of Engineers, U. S. A., 1916) preceded Mr. Wallace. **P-04,** 36, 78, 79.

[3] Maj. Gen. G. W. Davis, member of I. C. C. No. 2. Appointed governor, etc., May 8, 1904. **R.** dated Nov. 1, 1904.

Table of subjects in the reports indexed in Part V.

1905–1906.

No.	Pages of this Index.	Reports.	Paging of the reports.	
			1905	1906
64	2528	**Isthmian Canal Commission (No. 3)**[1]	1–340	1–153
65	2528	Organization and reorganization	5	15, 151
66	2585	Health and sanitation	6	2
67	2460	Employees, care of, and obtaining	7–8	3–6
68	2487	Labor (including transportation, etc.)	9–10	5
69	2508	Material and supplies	15–16	11
70	2547	Plant, production of	16–17	....
71	2572	Ships, purchases	17	....
72	2600	Telegraphs and cables	18	....
73	2542	Panama R. R.	18	10
74	2521	Monetary system	20	12
75	2395	Auditing, etc	20	....
76	2620	Finances (fiscal matters)	21	12, 118
77	2620	Governor of zone (**R.**)[2]	28–107	17–45
78	2546	Relations with Panama (Republic)	....	18
79	2618	Yellow fever	29	....
80	2483	Immigration, restriction of	....	19
81	2507	Malaria	34	....
82	2480	Harbor regulations	....	21
83	2403	Bubonic plague	35	....
84	2526	Pipe line, oil	....	22
85	2585	Sanitation of the Isthmus	38	....
86	2585	Sanitation, near-by countries	....	22
87	2616	Water supply (drinking)	39	....
88	2590	Sewers	41	....
89	2546	Paving	42	....
90	2573	Living quarters	44	....
91	2475	Food supply	46	....
92	2620	Delimitation of zone	47	....
93	2441	Consuls	48	....
94	2430	Commissaries	48	....
95	2450	Currency agreement	49	....
96	2583	Roads	50	....
97	2483	Care of insane, etc	50	....
98	2525	Nurses, religion	52	....
99	2526	Office buildings	52	26
100	2471	Expropriation	53	....
101	2460	Employees	54	....
102	2582	Religious work	58	....
103	2470	Executive office	58	27
104	2481	Health department	59	27
105	2585	Sanitation	59	24, 29
106	2481	Hospitals	60	23, 28
107	2573	Quarantine	61	30
108	2481	Laboratory	61	30
109	2582	Revenues	62	32
110	2450	Customs	63	33
111	2484	Internal revenue	64	....
112	2548	Postal service	64	32
113	2589	Public schools	65	....
114	2462	Estates	66	34
115	2489	Lands	66	33
116	2492	Legal department	....	41
117	2447	Courts, etc	67	41
118	2475	Fire department	....	36
119	2548	Police	69	43
120	2616	Water commissioner, office of	....	35
121	2524	Municipalities	71	24, 37

[1] Members: T. P. Shonts, chairman, to Mar. 4, 1907; C. E. Magoon, to Sept. 25, 1907; Rear Admiral M. T. Endicott, U. S. N., Col. P. C. Hains, Col. O. H. Ernst, U. S. A., B. M. Harrod, to Mar. 16, 1907. I. C. C. No. 3 appointed by President Roosevelt Apr. 3, 1905. I. C. C. No. 2 rendered its last **R.** Dec. 1, 1904. The last **R.** of the Chief Engineer was rendered Feb. 1, 1905. **R.** of I. C. C. No. 3, dated Dec. 6, 1905, for year ending Dec. 1, 1905. **R.** dated Dec. 6, 1906, for year ending Dec. 1, 1906.

[2] Chas. E. Magoon, head of department of government and sanitation and governor of Canal Zone. Appointed Apr. 1, 1905. **R.** dated Nov. 16, 1905, to cover year ending Oct. 31, 1905. **R.** dated Oct. 1, 1906, to cover from Nov. 1, 1905, to Sept. 30, 1906.

Table of subjects in the reports indexed in Part V.

1905–1906.

No.	Pages of this Index.	Reports.	Paging of the reports.	
			1905	1906
122	2589	Schools	....	39
123	2395	Audits and disbursements	72	....
124	2470	Estimates, etc	72	....
125	2419	Chief Engineer (R.)[1]	108–123	82–117
126	2487	Labor and quarters	109	114
127	2524	Municipal engineering	110	92
128	2616	Waterworks	....	92–97
129	2590	Sewers	111	92
130	2583	Roads	111	....
131	2546	Paving	112	93
132	2404	Building construction	112	99, 127
133	2509	Mechanical division	113	107
134	2426	Colon division	114	82
135	2487	La Boca division	115	88
136	2599	Chagres R. surveys and division	116	85
137	2507	Maps and lithography	116	114
138	2518	Meteorology and river hydraulics	116	113
139	2449	Culebra division	117	86
140	2541	Panama R. R	121	....
141	2440	Conditions,[2] Isthmus, July 1, 1905	124–132	....
142	2440	.....do.[3]	133–146	....
143	2440	.....do.[4]	139–145	....
144	2529	Washington office organization	148	....
145	2461	Department of construction and engineering—organization	151	....
146	2460	Employment—conditions	157	....
147	2572	Purchases, etc.—regulations	159–170	....
148	2396	Bids—form of proposal	171	....
149	2395	Auditing—organization	179–180	....
150	2470	Expenditures—details	181–193	....
151	2581	Receipts	194	118
152	2528	Laws, orders, and resolutions of I. C. C. No. 2 subsequent to previous R.[5]	195, 340	....
153	2618	Yards, receiving and forwarding	....	8
154	2601	Yards, terminal; and wharves	....	8
155	2616	Water and sewer systems, Panama	....	8
156	2616	Water and sewer systems, Colon and Cristobal	....	9
157	2580	Railway equipment	....	10
158	2425	Clerical force—classification	....	12
159	2549	Canal type—lock plan decreed	....	13
160	2493	Legislation	....	14
161	2565	Locks and dams, location	....	14
162	2487	Labor, Chinese	....	14
163	2441	Construction of canal by contract	....	15, 128, 132

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[1] Jno. F. Stevens, Chief Engineer to Apr. 1, 1907. Appointed July 1, 1905. **R.** dated Sept. 30, 1905, for 3 months ending Sept. 30, 1905.

[2] **R.** by Chief Engineer Stevens.

[3] **R.** by Col. P. C. Hains and B. M. Harrod of what had actually been done by Chief Engineer Wallace from June 1, 1904, to June 28, 1905.

[4] **R.** by Col. O. H. Ernst.

[5] Embracing details of 61st meeting of I. C. C. No. 2 from Dec. 8, 1904, to 90th meeting, Mar. 29, 1905.

Table of subjects in the reports indexed in Part V.

1906.*

No.	Pages of this Index.	Reports.	1906
			Paging of the reports.
164	2396	**Board of Consulting Engineers of 1906**[1]	1–426
165	2396	Summary of proceedings	9
166	2397	Physical characteristics—Panama	15
167	2397	Climate	16
168	2397	Sanitation and hygiene	18
169	2397	"Present conditions"	22
170		Projects—	
	2566	Bates	26,247
171	2567	Bunau-Varilla	30,199
172	2566	I. C. C. No. 1 (1901)	33
173	2566	Gillette	34
174	2567	60-foot summit level *v.* sea level	35
175	2453	Defense	36
176	2567	Lock canal transformation to sea-level canal	38
177	2568	Capacity of canal for traffic	39
178	2583	Control of Chagres, etc	41
179	2451	Dams	45
180	2565	Sea-level plan recommended by board	47
181	2565	Lock canal recommended by minority	67
182	2565	Comparison—lock *v.* sea-level plan	79
183	2565	Time of completion—sea level and 85-foot projects	83
184	2569	Relative time of transit	85
185	2576	Capacity for traffic of two projects	86
186	2570	Safety of locks and structures	89
187	2569	Safety of ships in two types of canal	92
188	2570	Land damages	93
189	2570	Relocation of Panama R. R	94
190	2569	Estimate, lock canal	95
191	2570	Upkeep, etc	96
192	2570	Dams	98
193	2396	Proceedings of B. C. E.[2]	105–148
194	2479	Geological study, Isthmus of Panama, by Bertrand and Zürcher [3]	149–163
195	2481	Dimensions of largest ships and improvements in channels and harbors, by Guerard	165–170
196	2406	Principal canals of the world	171–184
197	2482	Hydraulics, Panama Canal	185–197
198	2481	Depth of harbors	267
199	2451	Gatun Dam—C. O. Ward	279
200	2397	Hearings before B. C. E	283–393
201	2397	J. F. Stevens	283
202	2398	F. B. Maltby	296
203	2398	H. F. Dose	307
204	2399	C. Bertoncini	315
205	2399	W. E. Dauchy	321
206	2400	J. F. Wallace	346,375
		Notes of	350
		Diagram, Culebra excavation	372
207	2448	Excavation, summary of, July 1, 1904, to Oct. 1, 1905	395
208	2406	Traffic capacity, lock canal, 85-foot summit level, by Noble and Ripley	397
209	2506	Time to pass locks at Bohio or Gatun, by Welcker	403
210	2580	Equipment recommended for excavation, by I. Randolph	405
211	2586	Vital statistics, by Gorgas	407
212	2405	Transformation of lock canal into sea-level canal	411
213	2549	History of Panama Canal; sketch by A. Noble	415
214	2397	Unit prices	419
215	2617	Artificial waterways, their improvement and navigation	421
216	2565	Estimates, lock canal	425

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[1] Appointed June 24, 1905, by President Roosevelt. Gen. G. W. Davis, U. S. A.; Alfred Noble, W. B. Parsons, W. H. Burr, Gen. H. L. Abbot, U. S. A.; F. P. Stearns, Joseph Ripley, Isham Randolph, for the U. S. A.; W. H. Hunter, British Government; Eugén Tincauzer, German Government; Adolphe Guerard, French Government; E. Quellenec, consulting engineer, Suez Canal; and J. W. Welcker, the Netherlands. To consider "various plans proposed * * * for canal * * * the deliberations * * * shall continue as long as they may deem necessary * * * before they make their **R.** to the commission (I. C. C. No. 3)." **R.** Jan. 10, 1906. Majority **R.** in favor of sea-level plan. Minority **R.** for lock canal. Signed by A. Noble, H. L. Abbot, F. P. Stearns, J. Ripley, and I. Randolph. **R.** of I. C. C. No. 3, dated Feb. 5, 1905. Majority of commission favor lock-canal plan. Minority **R.** (M. T. Endicott) favored sea-level plan. Secretary, Capt. J. C. Oakes, Corps of Engineers, U. S. A.

[2] From Sept. 1, 1905, Washington, D. C., to 30th meeting, New York, Jan. 31, 1906.

[3] Translated by Capt. J. C. Oakes, secretary, Board of Consulting Engineers. (See No. 223, p. 2366 of this Index.)

Table of subjects in the reports indexed in Part V.

1907-1914.

No.	Pages of this Index.	Reports.	Paging of the reports.							
			1907	1908	1909	1910	1911	1912	1913	1914[4]
217	2484	**Isthmian Canal Commission (No. 4)**[1]	1-239	1-358	1-356	[2]1-443	[2]1-581	[2]1-618	[2]1-633	1-603
218	2480	Chairman and Chief Engineer[3] (Lt. Col. Geo. W. Goethals, Corps of Engineers, Col., 1910)	1-38	1-34	1-32	1-46	1-63	1-68	1-71	[4]1-66
219	2464	Department of excavation and dredging (Maj. D. D. Gaillard, Corps of Engineers)	39	35	......	......	......	......	......	......
220	2497	Department of lock and dam construction (Maj. W. L. Sibert, Corps of Engineers)	54	57	......	......	......	......	......	......
221	2522 2548	Department, municipal engineering, motive power and machinery, and building construction (Civil Engineer H. H. Rousseau, U. S. N.)	59	71	......	......	......	......	......	......
222	2508	Division, material and supplies (W. G. Tubby)	103	221	......	......	......	......	......	......
223	2479	Geology (Ernest Howe). (D. F. MacDonald, 1912)	108	......	......	......	......	[5]205	[5]565	......
224	2487	Department, labor, quarters and subsistence, (Jackson Smith, to 1908)	139	[6]247	......	......	......	......	......	......
225	2419 2619	Department, civil administration (Jo. C. S. Blackburn.[1] M. H. Thatcher, 1910–1913. Col. Geo. W. Goethals, 1913–)	144	255	257	[7]363	413	455	......	......
226	2585	Department, sanitation (Col. W. C. Gorgas)	188	281	289	409	503	529	527	......
227	2614	General purchasing officer and Washington office (Lt. Col. H. F. Hodges, Corps of Engineers)	211	355	[8]353	439	537	561	561	......
228	2376	Expenditures, classified, 1906–07 (H. L. Stuntz)	214	......	......	......	......	......	......	......
229	2375 2462	Estimates, appropriations, 1908–09	215	......	......	......	......	......	......	......
230	2419	Organization—charts	239	......	357	443	541	619	633	......
231	2476 2498	Foundations, Gatun Locks (Maj. C. Harding, Corps of Engineers)	......	121	......	......	......	......	......	......
232	2451 2498	Gatun Dam investigations (C. M. Saville, assistant engineer)	......	127	......	......	......	......	......	......

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[1] Members of commission No. 4: 1907—Lt. Col. Geo. W. Goethals, Corps of Engineers, chairman and chief engineer, to Apr. 1, 1914; Maj. D. D. Gaillard, Corps of Engineers, to Apr. 1, 1914; Maj. Wm. L. Sibert, Corps of Engineers, to Apr. 1, 1914; Civil Engineer H. H. Rousseau, U. S. N., to Apr. 1, 1914; Col. W. C. Gorgas, Medical Department, U. S. A., to Mar. 31, 1914; Jo. C. S. Blackburn, to Dec. 4, 1909 (see "Thatcher" below in 1910); Jackson Smith, to Sept. 14, 1908. I. C. C. No. 4 assumed its duties Apr. 1, 1907. Appointed by President Roosevelt. **Rs.** made thereafter for fiscal year ended. 1909—Lt. Col. H. F. Hodges, Corps of Engineers, appointed Sept. 14, 1908, to Apr. 1, 1914. 1910—Hon. M. H. Thatcher, appointed Apr. 12, 1910, to June 14, 1913.

[2] Plus portfolio of plates.

[3] Assistant chief engineer, Lt. Col. H. F. Hodges, 1909. (See footnotes, pp. 2361-2368, for Engineers.)

[4] Prior to 1914 **R.**, the **Rs.** are rendered as the **Rs.** of the I. C. C. The 1914 **R.** is rendered as the **R.** of both the Isthmian Canal Commission and "The Panama Canal," dated at the "Office of the Governor"; and signed by the "Governor." Effective Apr. 1, 1914, by Executive order and in conformity with Panama Canal act of Aug. 24, 1912, "existing organization" abolished, and "the one" contemplated by the act, viz, "The Panama Canal," made effective. **P-14,** 3.

[5] "Land Slides—Culebra Cut." (See No. 194, p. 2365 of this Index.)

[6] Signed by 1st Lt. R. E. Wood, 3d Cavalry, U. S. A., assistant manager.

[7] **Rs.,** 1910-12, signed by Hon. M. H. Thatcher, member I. C. C. No. 4.

[8] Capt. F. C. Boggs, 1908-14; Maj., 1911.

Table of subjects in the reports indexed in Part V.

1907-1914.

No.	Pages of this Index.	Reports.	Paging of the reports.							
			1907	1908	1909	1910	1911	1912	1913	1914
233	2478 2497	Designs, lock gates and movable dams (Lt. Col. H. F. Hodges, Corps of Engineers)	......	197	......	......	......	......	......	......
234	2542	Panama R. R. Co. (H. J. Slifer, general manager [1])	......	201	135	[1] 197	[2] 193	[2] 281	[2] 269	......
235	2375	Expenditures, inception to June 30, 1908	......	218	......	......	......	......	......	......
236	2454	Disbursing officer (E. J. Williams)	......	324	253	361	411	453	451	......
237	2369	Examiner of accounts (W. W. Warwick, 1910. H. A. A. Smith, 1911)	......	343	231	337	385	407	411	......
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[1] R. for 1910 signed by F. Mears, chief engineer.

[2] R. for 1911 signed by Lt. F. Mears, U. S. A.

[3] R. for 1910 signed by F. C. Freeman.

[4] R., 1913, signed by A. B. Dickson.

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Accounts and Disbursements, 1904-1914.

1904. System established after consultation with Secretary of Treasury and other officials. Disbursing officer selected; disbursements to be by customary U. S. methods; disbursing officer to be treasurer of the zone. **P-04,** 53.

1908. Administrative examination of the disbursing officer's accounts before their transmission to the Auditor for the War Department; inspection of the accounts of all officials of the commission, on the Isthmus, charged with the care of funds or property; time inspection by which the time books in the hands of the timekeepers and foremen engaged upon the work of all departments is checked; checking collections made by the disbursing officer from the record of claims payable to the Isthmian Canal Commission. Examiner of accounts also the auditor for the zone. Created by Executive order Aug. 15, 1907, when the positions of general auditor and local auditor were abolished. **P-08,** 29, 30.

1909. Organization: Rearrangement of duties made Oct. 1, 1908, so that the examiner of accounts performs, in addition to the duties outlined previously, those of the disbursing officer, with the exception of the disbursement of funds, collection of accounts and claims, and issuance of coupon books and meal tickets. Property accounts were transferred to the Q. M. department. Treasurer appointed Oct. 1, 1908, to handle zone funds. Changes resulted in decreased employees and expense.

Examiner of accounts, duties: Division of accounts, in charge of the books of the Isthmian Canal Commission; classification of expenditures and statistical work; handling of bills due the Isthmian Canal Commission; and accounting for coupon books and meal tickets.

Voucher division, which handles the claims and accounts presented for payment.

Inspection division, which has charge of inspecting books and accounts of all employees having to do with the receipt and disbursement of money and the custody and issuance of coupon books and meal tickets, examining and checking time kept by foremen and in shops, and reporting the neglect or misuse of U. S. property.

The pay roll division, which examines and checks all rolls of the Isthmian Canal Commission.

Audit: Advance audit secured prior to payment.

Liability act: Claim officer of the Isthmian Canal Commission has been connected with the examiner of accounts' office, in connection with the employers' liability act May 30, 1908, subsequently modified by act Feb. 24, 1909. Classes under Isthmian Canal Commission given relief by Congress fewer than in any other branch of the service; hardship in some cases. Delays caused through long distance, etc. Time would be saved through settlement of claims on Isthmus. **P-09,** 24, 25.

Disbursing officer, duties: In addition to securing, disbursing, and accounting for all funds paid out or collected, is charged with care and issuance of hotel and commissary books and meal tickets by the various departments of the Isthmian Canal Commission. **P-09,** 25, 26.

1910. Bookkeeping improvements made in the classification of expenditures and the compilation of statistics. Distribution of accumulated plant charges made; plant now shown in the expenditure accounts by divisions and by units of the work.

Four inspectors engaged inspecting accounts of bonded employees on Isthmus, and witnessing transfers. Cash accounts inspected and verified at regular intervals. Coupon and meal-ticket accounts inspected about once a month. Twice during the year cash in hands of disbursing officer counted. Money in hands of the treasurer of the Canal Zone verified.

For convenience of time inspection, Isthmus divided into 5 districts, with senior inspectors located at Ancon, Empire, Gorgona, Gatun, and Cristobal.' Time inspectors increased from 41 to 46. Gangs on hourly basis inspected 3 or 4 times a week; some every day. Twelve men engaged in inspecting time keeping in all time keeping offices; examination made to see if pay rolls contain only amount of time on rolls; time of sickness, court attendance, etc., verified from certificates attached to rolls.

Claims of employees on account of personal injuries largely increased; paid on injuries, $96,810.33; on death claims, $21,053.22. Paid on meritorious sick leave, $16,010.30. Separate pay roll established for compensation to injured employees.

The classes of persons under the Isthmian Canal Commission given relief by Congress are fewer than in any other branch of the service covered by law; has imposed hardships in some cases. Distance from Washington, etc., has caused much work which would not be required if claims settled on the Isthmus, where facts can be readily determined.

Examiner of accounts also auditor for Canal Zone government. More than $1,000,000 kept on deposit in a bank in the city of Washington; principally money-order funds held pending settlement. Interest (3¼ per cent), $36,867.94, received on this deposit; credited as revenue of the Canal Zone for public improvements and schools. **P-10,** 39, 40.

1911. The number of bills rendered against employees and other individuals and companies reduced by improved methods of collection. Considerable decrease in monthly average of bills rendered; volume of business materially increased. Accounts of bonded employees charged with collection of revenues audited and balanced each month.

For the past 3 years coupon books and meal tickets issued by disbursing officer on requisition of bonded employees. Saving effected during the year by the adoption of uniform meal tickets of 30 and 40 cent denominations; 520,000 coupon books and 1,428,000 meal tickets issued. Proposition for sale of coupon books for cash under consideration.

Improvement made in handling claims, by consolidation of smaller accounts into one and the rendition of monthly claim; $10,077,000 audited and paid; at the close of the fiscal year unpaid claims on hand, $454,000.

Administrative examination of the disbursing officer's account made monthly. Careful permanent record maintained of unpaid salaries and wages due employees of the commission; record gradually increasing. Unpaid salaries and wages June 30, 1911, $217,031.86.

Supervision and direction of time keeping and questions relating thereto placed under examiner of accounts; the effect a more uniform method among all departments and divisions of handling questions relating to time keeping; greatly improved form in which the pay rolls are submitted for examination.

The inspection of the accounts of all bonded employees continued during the year with force of 3 inspectors, a reduction of 1. Monthly accounts rendered by all financially responsible employees; accounts audited and balanced at close of each monthly period.

Time inspection increased because of field covered; gradually grown larger. Average of 29 men engaged on this work, in addition to 5 senior inspectors located at Ancon, Culebra, Gorgona, Gatun, and Cristobal. On May 1, 1911, senior inspectors reduced to 4; districts rearranged, with headquarters at Ancon, Empire, Gatun, and Cristobal. Average inspections daily, 11,368; in addition, 3,000 special reports.

Cash balance of disbursing officer verified; detailed count made Dec. 31, 1910, and May 31, 1911.

Under the existing agreement with the Republic of Panama whereby U. S. is to construct and maintain waterworks, and be reimbursed at expiration of 50-year period, with interest at 2 per cent per annum, there had been expended on June 30, 1911, $1,461,303.31 in the city of Panama and $1,225,922.50 in the city of Colon. Republic of Panama has been credited with $568,690.45; balance still to be paid, $2,118,535.36. Of amount credited, $22,420.63 represents the water rentals paid by Isthmian Canal Commission and Panama R. R. Co. in Panama and Colon, and $546,269.82 represents collections for water rentals.

Examiner of accounts also handles claims under employer's liability act; adjusted 1,619 claims developed from 1,573 injuries and 112 deaths. The sundry civil appropriation, Mar. 4, 1911, sec. 5, extended provisions of the injury compensation law to all employees under the Isthmian Canal Commission injured or killed, and provided that claims should be settled by chairman, Isthmian Canal Commission. Result, settlements made in considerably less time.

Accounts of all fiscal officers of zone audited and balanced each month; involved examination of 552 monthly accounts. Funds of the treasurer maintained in 2 banks in Washington and in 1 depository on Isthmus. Average monthly balance at Washington, $881,620.75; on Isthmus, $43,239.99, from which $27,763.40 interest received. P-11, 45, 46, 47, 48.

1912. The system of classified expenditures for construction of canal extended to include accounts for department of law, terminal facilities at Cristobal and Balboa, lighting and buoying the canal, inspection of lock gates, installation of lock machinery, emergency dams, and fortifications. Since establishment of method of absorbing plant charges, begun July 1, 1909, $25,226,779.74 charged to construction costs up to June 30, 1912, leaving $3,590,949.49 still to be absorbed. Classification of accounts recommended by the Commission on Economy and Efficiency for all U. S. departments would necessitate radical departure and confusion; recommended new system be not put in force on the Isthmus until after accounting method has been adopted for operation and maintenance of canal; approved by President.

Accounts of employees making collections audited. Bills against employees and outside parties for charges due the Isthmian Canal Commission increased; monthly average, 490.

Examination of disbursing officer's accounts made monthly. Check made of unpaid salaries and wages representing amounts earned by employees, not collected; balance, accumulating since beginning of work, $238,634.02, June 30, 1912.

Under revised agreement with Panama for the construction and maintenance of waterworks, sewers, and pavements within Panama and Colon and for reimbursement to U. S., there were expended $1,432,110.68 in Panama and $1,297,566.04 in Colon, a total of $2,729,676.72; during the same period $757,025.76 reimbursed, of which $219,163.92 was interest, leaving balance due U. S., $2,191,814.88. Included in reimbursed amount is $27,830.51, value of water used by Isthmian Canal Commission in the two cities.

Forty-nine bonded employees engaged in issuing coupon books and meal tickets; 593,900 coupon books and over 1,700,000 meal tickets issued. On June 1, 1912, the method of selling commissary books for cash by the Panama R. R. Co. was installed at several points, in addition to existing practice of issuing books for payment by pay roll deduction; reduced work of issuing clerks, increased volume of business in the commissaries during the early and latter parts of the month on the days when the issue of commissary books was prohibited. Purchase and issue of commissary books to issuing clerks transferred to Panama R. R. Co. on July 1, 1912; $3,123,220.96 paid Panama R. R. Co. on account of commissary coupon books issued and collected by Isthmian Canal Commission.

Accounts of bonded employees charged with collection of funds inspected. A more complete and detailed checking of accounts of post offices, hospitals, and Hotel Tivoli instituted, made necessary by increasing business and installation of postal-savings system. Effective Nov. 1, 1909, Illinois Surety Co. executed schedule bond covering employees of the Isthmian Canal Commission and the zone government who were required to give bond under the regulations; bond to run for 3 years. Arrangements made with surety company to continue bond in effect from year to year from July 1, 1912, at the rate heretofore paid—$3 per thousand.

Claims audited and vouchers prepared 3,440, involving disbursements of $10,440,047.25; over $9,000,000 represents payments to Panama R. R. Co. Increase in claims largely due to payments to landowners and others in region to be occupied by Gatun Lake. Unsettled claims at end of year, $114,176.99, of which $73,107.05 included several large claims for land purchased but not completed for payment.

To largest division of office is assigned duty of auditing pay rolls of Isthmian Canal Commission and keeping up personnel file of gold employees. One hundred and twenty-one pay rolls each month; over 36,000 payments, involving approximate monthly disbursements of $1,500,000. To this division is assigned duty of examining recommendations for sick leave; 5,141 cases; in payments, $55,838.25.

In time-inspection division, districts reduced to 3; senior inspectors located at Ancon, Empire, and Gatun; reduction in inspectors made from 46 to 42.

Verification of cash balance in hands of disbursing officer made on Sept. 1 and Nov. 1, 1911; complete check, including count of all cash, made Dec. 15, 1911.

In accordance with sec. 5 of act of Mar. 4, 1911, 1,849 claims filed during year on account of injuries and 50 deaths—total, 1,899; 1,410 injury claims and 31 death claims allowed. Total amount paid during the year in these claims, $259,993.14. From Aug. 1, 1908, to June 30, 1912, $691,753.07 paid to employees for injuries received in course of employment, including sick leaves.

Congress has appropriated $293,561,468.58 on account of canal work and chargeable against the authorized bond issue. To June 30, 1912, $5,856,426.77 collected and returned to Treasury as "miscellaneous receipts," and this amount should be deducted from the total appropriations in order to determine the net amount available for actual canal purposes. On the other hand, Isthmian Canal Commission has received benefits from moneys collected which were not expected when the estimates of 1908 were prepared, namely, water rentals paid by Republic of Panama as a repayment of the amount expended in installing waterworks, sewers, and pavements in Panama and Colon, and the net receipts from sale of scrap. To June 30 Isthmian Canal Commission has had the use of $626,654.54, received from the water rentals;

$67,492.60, received from the sale of French scrap, and $98,605.75, received from the sale of American scrap, or a total of $791,752.89. Total amount available for canal work under its various departments to June 30, 1912, therefore, $288,496,794.70.

The total zone revenues for year, $370,272.81; expenditures, $312,459.75. Increase in expenditures during year principally due to increase in construction and maintenance of roads and trails and payments made steamship companies on account of ocean transportation of mails from 1905 to 1912. Falling off in revenues, due to abandonment of some districts; as other towns are abandoned, revenues will continue to be reduced. Average monthly balance in Washington, $1,121,707.64; on deposit on Isthmus, $43,625.73; interest, $20,784.96. P-12, 54, 55.

1913. Effective May 1, 1913, greater part of detail check made by disbursing officer of every voucher, pay roll and pay receipt discontinued; responsibility formerly carried by the clerks of the disbursing office for such check transferred to clerks in pay roll and voucher division of examiner of accounts' office. Effective Jan. 1, 1913, time-keeping division organized by consolidating the work of preparing time and pay rolls for various departments and divisions, and continued under this department until July 1, 1913, when it was transferred to the fourth division of the chief engineer's office.

The only change made in accounting system during year was extension of the classified expenditure accounts to provide for new operations, including construction of new buildings, electric transmission line, and clearing the lake, and a further separation of accounts for construction and maintenance of waterworks and sewers to care for permanent water supply. Material and supply account closed at the end of the year and a new account opened, designed to provide a more exact record of material and supplies on hand and issued. Continuance of the method of absorbing plant and equipment charges resulted in distributing plant charges of $27,550,635.24 to construction divisions to June 30, 1913, leaving to be absorbed $1,941,488.61. Cash payments for materials and supplies furnished and services rendered adopted during the year. Collection of money due the Isthmian Canal Commission considerably reduced.

Total amount expended in city of Panama, $1,626,267.58, and in city of Colon $1,550,030.46, a total of $3,176,298.04, including interest; this interest has aggregated $270,733.72. At close of year $975,439.71 reimbursed; included in this, $32,785.01, value of water used by Isthmian Canal Commission in the two cities.

Purchasing and issuing commissary coupon books transferred to Panama R. R. Co.; work of department reduced but little; 60,790 hotel books and 1,363,100 meal tickets issued. In addition, $3,235,122 worth of commissary books issued and collected on pay rolls.

Administrative examination of disbursing officer's accounts made monthly; periodical examination of fiscal officers' records of financial transactions and auditing of their accounts continued, involving complete check of records and cash and cash values in hands of over 200 officers. There were passed to disbursing officer for payment audited vouchers amounting to $9,022,000 and pay rolls amounting to $20,700,000. At close of business June 30 there were unaudited claims of $57,197, the greater portion in favor of the Panama R. R. Co. Force assigned to inspection of time books reduced. A few cases of padded time books discovered; 5 or 6 negro timekeepers, foremen, and laborers convicted.

One thousand eight hundred and nine claims for compensation on account of injuries filed, and 41 claims were filed on account of deaths—a total of 1,850; 1,452 claims for injuries allowed. Of the death claims, 21 were allowed; 4,715 cases sick leave allowed. Total amount expended during the year in settlement of these claims, $224,071.72; total, Aug. 1, 1909, to June 30, 1913, $915,824.79.

Congress has appropriated $339,506,223.14 for canal construction, including appropriations contained in the act of June 23, 1913. Of this amount, $10,676,950 for fortifications, of which $4,870,000 were appropriated by act of June 23, 1913, and $21,411.56 for relief of private persons. The balance, $338,806,861.58, including $16,265,393 appropriated by act June 23, 1913, appropriated for construction of canal and is a charge against the total authorized bond issue of $375,200,900. This leaves $36,394,038.42 available for appropriation. Actual cash balance on hand June 30, 1913, for the construction of the canal, excluding amount available for fortifications, $20,673,904.79. Up to June 30, 1913, $5,956,638.35 collected and returned to Treasury as miscellaneous receipts. This item represents the total amount appropriated by Congress which, after being used for miscellaneous purposes in connection with canal work, was covered back into Treasury and lost to canal appropriations.

The amount of revenues derived from rentals and taxation of zone decreased from $259,759.68 in 1912 to $212,266.53 in 1913. Disbursement of Canal Zone revenues increased from $214,000 in 1912 to $233,000 in 1913; increase being principally due to sanitary work in native villages and increased expenditure for maintenance of Canal Zone roads and trails. P-13, 58, 59, 60, 61.

1914. Department organized Apr. 1, 1914, in accordance with the provisions of the Executive order putting into effect the new organization, and consists of the auditor, Mr. H. A. A. Smith, who has supervision of the entire department and is in direct charge of the auditing and accounting work; Mr. J. H. McLean is in direct charge of disbursements, and Mr. T. L. Clear of all collections.

Attempt made to revise system of accounting that has been in effect during the construction period so as to make it applicable to the operation of the canal. The assistance of the Treasury Department sought, and 2 committees visited the Isthmus; result, the approval of certain forms for use in connection with the rendition of public accounts. New classification of accounts established beginning with the fiscal year 1915.

Expenditures to June 30, 1914, in city of Panama, were $1,761,328.49 and in city of Colon $1,659,640.20; a total of $3,420,968.69, including accrued interest. For work in Panama, this interest $186,588.26, and for work in Colon, $139,665.63. Reimbursed to the U. S., $1,213,918.37; leaving balance of $2,207,050.32 still due.

Forty-one thousand two hundred and thirty-three hotel books, valued at $580,319.40, and 980,283 meal tickets, valued at $353,253.20, issued. In addition, $2,888,437.50 collected on the pay rolls for commissary books issued to canal employees.

Examination of accounts of 225 officers and employees having collection, custody, and disbursement of money made.

Total disbursements on Isthmus on account of salaries and wages of employees, etc., $27,749,135.69. Disbursements in U. S., $14,614,403.71; total of $42,363,539.40.

Total collections during year, $8,106,469.42; of which $4,718,024.30 repaid to appropriations, $379,365.02 deposited as miscellaneous receipts, and $2,963,148.96 collected on account of Panama R. R. commissary. Balance, $27,931.14, collected for railroad, bonding company, and other contractors.

Inspection of time books and the work of timekeepers in the field continued.

Property accounting transferred to this department on Jan. 1, 1914; for 6 months that it had charge, records maintained of purchases and sales of quartermaster's stores, and material and supplies received of value of $7,887,431.66, of which $4,840,245.92 were for stock and $3,047,185.74 were for material, supplies, and equipment delivered direct to construction divisions. During this period issues from storehouses amounted to $5,423,585.41; amount received from direct sales to outside interests, $142,377.56.

Separate business of zone reduced materially during year. Revenue derived from rentals, taxation, etc., decreased from $212,266.83, 1913, to $168,076.64, 1914. Audited expenditures, $261,064.17. In operation of post offices there was decrease in number of orders, 228,316, 1913; 198,009, 1914.

Canal clubhouses received total revenue of $132,624.05 and expended $133,086.95. Balance June 30, 1914, clubhouse funds amounted to $26,513.96; outstanding obligations, $10,534.53.

Provisions of injury compensation act May 30, 1908, superseded Apr. 1, 1914, by Executive order of Mar. 20, 1914, promulgated in accordance with authority contained in sec. 5 of the Panama Canal act. Since Aug. 1, 1908, the sum paid out in injury claims amounted to $1,145,065.71. For the first 3 months under the compensation order of Mar. 20, 1914, $4,283.83 expended. This does not represent the total that will be allowed on account of injuries received during the period, as no allowances were made on account of long-continuing periods of disability nor on account of death claims.

Congress has appropriated total of $374,048,194.59 for canal, including appropriation continued in the sundry civil act approved Aug. 1, 1914. Of this amount, $12,050,825 for fortifications and $22,508.01 appropriated for relief of private persons, so that there were $361,974,861.58, including the amount covered by the sundry civil act of Aug. 1, 1914, appropriated for cont struction of canal and its adjuncts. Excep for portion used in maintaining and operating the canal, to which $161,608.52 were charged, and $2,000,000 appropriated for colliers, the amount chargeable against the total authorized bond issue of $375,200,900 is $359,813,253.06; up to June 30, 1914, $6,254,203.37 collected and returned to Treasury as miscellaneous receipts, so that the cost of the canal, including appropriation of Aug. 1, 1914, stands at $353,559,049.69. **P-14**, 52, 53, 54.

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TABLE A.—APPROPRIATIONS BY CONGRESS. (See P-99, 10; P-14, 330.)

1899.—

Act Mar. 3, 1899 (Isthmian Canal Commission, No. 1, 1899)		$1,000,000.00

1902–1905.—

Canal rights from French company (act of June 28, 1902)		40,000,000.00
Canal Zone rights from Republic of Panama (act of Apr. 28, 1904)		10,000,000.00
Canal connecting Atlantic and Pacific Oceans		21,000,000.00
Act of June 28, 1902	$10,000,000.00	
Act of Dec. 21, 1905	11,000,000.00	
Deficiency for fiscal year 1906 (act of Feb. 27, 1906)		5,990,786.00
Miscellaneous material purchases in United States	1,000,000.00	
Miscellaneous material purchases on Isthmus	400,000.00	
Payments to Panama R. R. Co.	200,000.00	
Isthmus pay rolls	2,100,000.00	
Salaries and services in the United States	75,000.00	
New equipment purchases	1,565,786.00	
Reequipment of Panama R. R.	650,000.00	
Total for purchase of rights and for lump-sum appropriations common to all departments		76,990,786.00

1907–1914.—

	Total.	Act of June 30, 1906 (f. y. 1907).	Acts of Mar. 4, 1907, and Feb. 15, 1908 (f. y. 1908).	Acts of May 27, 1908, and Mar. 4, 1909 (f. y. 1909).
Expenses in the United States:				
Salaries	$1,326,056.33	$251,063.33	$202,600.00	$149,000.00
Incidental expenses	521,179.36	117,179.36	69,000.00	27,000.00
Construction and engineering:				
Officers and employees	27,029,212.00	2,650,512.00	2,982,700.00	4,000,000.00
Skilled and unskilled laborers	94,809,961.00	9,050,661.00	13,526,300.00	10,858,000.00
Miscellaneous material purchases	100,881,514.24	9,032,814.24	15,131,700.00	15,200,000.00
Incidental expenses on Isthmus	5,915,250.00	434,550.00	715,700.00	400,000.00
Civil administration:				
Officers and employees	4,007,000.00	600,000.00	486,000.00	225,000.00
Skilled and unskilled laborers	191,000.00	50,000.00	50,000.00	16,000.00
Material and expenses	1,106,200.00	318,200.00	289,000.00	....
Sanitary department:				
Officers and employees	5,091,000.00	550,000.00	766,000.00	700,000.00
Skilled and unskilled laborers	2,916,968.00	579,068.00	637,900.00	500,000.00
Material and expenses	5,287,367.15	822,367.15	800,000.00	375,000.00
Reequipment of Panama R. R.	4,185,000.00	1,000,000.00	1,385,000.00	1,100,000.00
Relocation of Panama R. R.	7,815,000.00	....	....	1,085,000.00
Redemption of first-mortgage bonds of Panama R. R. Co.	2,298,367.50	....	2,298,367.50	....
Sanitation, Panama and Colon	800,000.00	....	....	....
Survey of lands, Canal Zone	75,000.00	....	....	....
Pembroke B. Banton for injuries	10,000	....	....	10,000.00
Total regular fiscal year appropriations	244,103,175.58	25,456,415.08	27,161,367.50	29,187,000.00
Total deficiency appropriations	20,162,900.00	....	12,178,900.00	5,458,000.00
Total for fiscal years 1907 to 1914, inclusive, less fortifications	264,266,075.58	25,456,415.08	39,340,267.50	34,645,000.00

TABLE A.—APPROPRIATIONS BY CONGRESS—Continued.

1907-1914—Continued.

	Acts of Mar. 4, 1909, and Feb. 25, 1910 (f. y. 1910).	Act of June 25, 1910 (f. y. 1911).	Act of Mar. 4, 1911 (f. y. 1912).	Act of Aug. 24, 1912 (f. y. 1913).	Acts of June 23, 1913, and Apr. 6, 1914 (f. y. 1914).
Expenses in the United States:					
Salaries	$150,000.00	$140,000.00	$130,000.00	$150,000.00	$153,393.00
Incidental expenses	75,000.00	70,000.00	50,000.00	50,000.00	63,000.00
Construction and engineering:					
Officers and employees	3,871,000.00	3,900,000.00	3,900,000.00	3,000,000.00	2,725,000.00
Skilled and unskilled laborers	12,000,000.00	13,500,000.00	16,500,000.00	11,000,000.00	8,375,000.00
Miscellaneous material purchases	10,517,000.00	15,000,000.00	19,000,000.00	12,000,000.00	5,000,000.00
Incidental expenses on Isthmus	1,000,000.00	900,000.00	950,000.00	790,000.00	725,000.00
Civil administration:					
Officers and employees	546,000.00	600,000.00	550,000.00	500,000.00	500,000.00
Skilled and unskilled laborers	20,000.00	20,000.00	20,000.00	15,000.00	....
Material and expenses	140,000.00	100,000.00	110,000.00	75,000.00	74,000.00
Sanitary department:					
Officers and employees	725,000.00	600,000.00	600,000.00	700,000.00	450,000.00
Skilled and unskilled laborers	450,000.00	200,000.00	200,000.00	200,000.00	150,000.00
Material and expenses	740,000.00	750,000.00	800,000.00	500,000.00	500,000.00
Reequipment of Panama R. R.	700,000.00	....	....	....	....
Relocation of Panama R. R.	1,980,000.00	2,000,000.00	2,750,000.00	....	....
Redemption of first-mortgage bonds of Panama R. R. Co.	....	....	....	....	....
Sanitation, Panama and Colon	800,000.00	....	....	....	....
Survey of lands, Canal Zone	....	75,000.00	....	....	....
Pembroke B. Banton for injuries	....	....	....	....	....
Total regular fiscal-year appropriations	33,638,000.00	37,855,000.00	45,560,000.00	28,980,000.00	16,265,393.00
Total deficiency appropriations	76,000.00	....	....	....	2,450,000.00
Total for fiscal years 1907 to 1914, inclusive, less fortifications	33,714,000.00	37,855,000.00	45,560,000.00	28,980,000.00	18,715,393.00

SUMMARY.

1899	$1,000,000.00
1902-1905	76,990,786.00
1907-1914 (See Table B)	264,266,075.58
Total	342,256,861.58
Fortifications	10,926,300.00
Relief acts	21,411.56
Court of Claims	1,096.45
Grand total (See Table C)	353,205,669.59

TABLE B.—DISTRIBUTION, 1907-1914.

(See Summary of Table A above.)

Expenses in the United States		$1,847,235.69
Salaries	$1,326,056.33	
Incidental expenses	521,179.36	
Construction and engineering		228,635,937.24
Pay of officers and employees	27,029,212.00	
Pay of skilled and unskilled laborers	94,809,961.00	
Miscellaneous material purchases, etc.	100,881,514.24	
Incidental expenses on Isthmus	5,915,250.00	
Civil administration		5,304,200.00
Pay of officers and employees	4,007,000.00	
Pay of skilled and unskilled laborers	191,000.00	
Material and expenses	1,106,200.00	
Sanitary department		13,295,335.15
Pay of officers and employees	5,091,000.00	
Pay of skilled and unskilled laborers	2,916,968.00	
Material and expenses	5,287,367.15	

TABLE B.—DISTRIBUTION, 1907-1914—Continued.

Reequipment of Panama R. R.		$4,185,000.00
Relocation of Panama R. R.		7,815,000.00
Redemption of first-mortgage bonds of Panama R. R. Co.		2,298,367.50
Sanitation in the cities of Panama and Colon		800,000.00
Survey of lands, Canal Zone		75,000.00
Relief of Pembroke B. Banton for injuries		10,000.00
Total for fiscal years 1907 to 1914, inclusive, less fortifications		264,266,075.58
Total for canal construction, rights, etc., to June 30, 1914		341,256,861.58
Fortifications		10,926,300.00
Armament of fortifications	$3,075,000.00	
Seacoast batteries	5,365,000.00	
Land for military purposes	50,000.00	
Surveys for military purposes	62,000.00	
Causeways	150,000.00	
Submarine mines structures	275,200.00	
Field fortifications and camps	394,350.00	
Manufacture and test of ammunition	575,000.00	
Submarine mines	111,750.00	
Electric light and power plants at fortifications	173,000.00	
Searchlights for seacoast fortifications	285,000.00	
Sanitary clearing, filling, etc.	210,000.00	
Fire control at fortifications	200,000.00	
Private acts for relief		21,411.56
Elizabeth G. Martin, June 17, 1910	1,200.00	
Marcellus Troxell, Jan. 13, 1911	1,500.00	
W. L. Miles, Feb. 13, 1911	1,704.18	
Chas. A. Caswell, Mar. 2, 1911	1,056.00	
Heirs of Robert S. Gill, July 3, 1912	2,520.00	
Douglas B. Thompson, July 3, 1912	1,500.00	
Allessandra Comba, July 10, 1912	500.00	
Peter Wiggington, Feb. 7, 1913	500.00	
Raymond R. Ridenour, Feb. 7, 1913	500.00	
Heirs of Chas. E. Stump, Feb. 7, 1913	1,500.00	
Parents of Edward Maher, Feb. 18, 1913	1,980.00	
Oscar F. Lackey, Feb. 18, 1913	1,500.00	
Pedro Sanchez, Feb. 18, 1913	2,000.00	
John H. Cole, Feb. 18, 1913	1,951.38	
Robert Coggan, Feb. 18, 1913	1,500.00	
Judgment of the Court of Claims, War		1,096.45
Act of Aug. 26, 1912	196.45	
Act of Mar. 4, 1913	900.00	

TABLE C.—STATEMENT OF MONEYS AVAILABLE FOR AND APPLIED TO THE PURCHASE OF CANAL RIGHTS AND COST OF CANAL CONSTRUCTION TO JUNE 30, 1914.

(See Summary of Table A above.)

Appropriations by Congress (Table A)			$353,205,669.59	
Less:				
Appropriations for fortifications		$10,926,300.00		
Private acts	$21,411.56			
Judgments, Court of Claims	1,096.45			
		22,508.01		
Collections returned to the United States Treasury as miscellaneous receipts and lost to canal appropriations		6,254,203.37		
			17,203,011.38	
Net amount available				336,002,658.21
Classified expenditures (Table D)			333,939,626.28	
Less:				
Fortifications	$6,793,089.73			
Private acts and judgments, Court of Claims	19,008.01			
		6,812,097.74		
Unapplied credits to expenditures—				
Water rentals		1,213,918.37		
French scrap used or sold		1,242,893.97		
Unpaid rolls on June 30, 1914	2,429,829.15			
Less unpaid amounts on rolls for fortifications	96,159.47			
		2,333,669.68		
Subsidies from Panama R. R. Co.		631,875.00		
Dividends from Panama R. R. stock		344,945.00		
Interest on loans to Panama R. R. Co.		473,194.27		
Miscellaneous rentals		239,099.57		
			13,291,693.60	
Net charges to classified expenditures			320,647,932.68	

TABLE C.—STATEMENT OF MONEYS AVAILABLE FOR AND APPLIED TO THE PURCHASE OF CANAL RIGHTS AND COST OF CANAL CONSTRUCTION TO JUNE 30, 1914.—Continued.

Material and supplies and other unclassified items less $71,199.88 for fortifications	$10,191,367.61	
Accounts receivable	1,406,156.75	
Due on Treasury Department transfers from fortifications	610,631.33	
Unexpended appropriation balances except $4,772,434.84 for fortifications and private acts	6,588,550.34	
Maintenance and operation of canal	161,608.52	
	339,606,247.23	
Less accounts payable	3,603,589.02	
Total accounted for		$336,002,658.21

TABLE D.—DETAILED STATEMENT OF CLASSIFIED EXPENDITURES FROM THE BEGINNING OF THE WORK TO DATE.

	Total to June 30, 1914.
Civil government and law:	
Administration	$656,977.20
Supreme and circuit courts	396,429.00
Prosecuting attorney	39,558.47
Division of revenues	196,019.21
Division of posts	846,494.06
Division of customs	88,853.79
Division of lands and buildings	102,046.07
Division of estates	33,601.04
Police and prisons	2,525,523.86
Fire protection	892,311.04
Maintenance and operation of waterworks and sewers—	
Panama	243,701.96
Colon	318,276.82
Repairs and maintenance of pavements—	
Panama	70,756.71
Colon	55,490.04
Miscellaneous zone public works	34,150.52
Treasurer of the Canal Zone	52,944.06
Construction of buildings	514,526.80
Repairs of buildings	25,075.05
Survey of Canal Zone lands	75,000.00
Office of counsel and chief attorney, special attorney	52,145.21
Land office	9,419.34
District court	3,349.14
District attorney	2,089.64
Canal Zone marshal	1,687.97
	7,231,357.10
Less amount prorated to—	
Cost of work done for and sales to private persons	8,011.99
Operation and maintenance of canal	5,940.58
Total, civil government and law	7,217 404.53
Health department:	
Administration	888,719.22
Hospitals and asylums—	
Medical storehouse, Colon	48,536.77
Ancon hospital	4,011,177.26
Colon hospital	1,965,410.32
Tobogo sanitarium	131,428.43
Santo Tomas hospital	72,447.82
Other hospitals, dispensaries, and sick camps	2,185,540.34
Quarantine	407,668.64
Sanitation, Panama and Colon—	
Sanitation proper, Panama	846,537.77
Disposal of garbage, street cleaning, etc., Panama	92,957.60
Sanitation proper, Colon	635,430.85
Disposal of garbage, street cleaning, etc., Colon	47,671.15
Zone sanitation—	
Sanitation proper	4,246,233.93
Disposal of garbage, street cleaning, etc	587,004.86
Construction of buildings	1,037,745.06
Repairs of buildings	110,726.46
Corozal farm	15,798.43
	17,281,035.00

TABLE D.—DETAILED STATEMENT OF CLASSIFIED EXPENDITURES FROM THE BEGINNING OF THE WORK TO DATE—Continued.

	Total to June 30, 1914.
Health department—Continued.	
Less amount prorated to—	
Cost of work done for and sales to private persons	$10,540.01
Operation and maintenance of canal	10,697.69
Total, health department	17,259,797.30
Department of construction and engineering:	
Atlantic district—	
Dry excavation (prism), construction work	1,483,709.72
Dredging excavation (prism)—	
Construction work	9,076,914.85
Plant	[1] 27,067.21
Gatun Dam and Spillway—	
Construction work	12,205,938.44
Plant	[1] 416,444.07
Gatun Locks—	
Construction work	30,004,213.49
Plant	109,036.36
Gatun power plant, permanent—	
Construction work	674,292.69
Plant	4,208.01
Rock and sand account—	
Porto Bello rock plant	17,093.84
Transportation plant	[1] 41,591.68
Colon Breakwater—	
Construction work	4,089,056.40
Plant	163,124.20
Gatun-Mindi Levee	119,005.31
Terminal facilities, Cristobal—	
Construction work	485,157.24
Plant	35,270.51
Clearing channel in Gatun Lake	[1] 2,014.58
Trinidad River Dam, construction work	37,810.65
Total, Atlantic district	58,017,714.17
Central district—	
Dry excavation—	
Construction work	86,012,107.67
Plant	[1] 116,837.53
Dredging excavation—	
Construction work	2,454,293.78
Plant	711,026.33
Clearing channel in Gatun Lake	157,151.18
Masonry—	
Construction work	12,432.77
Plant	....
Total, central district	89,230,174.20
Pacific district—	
Dry excavation (prism)—	
Construction work	3,511,930.46
Plant	[1] 94,618.98
Dredging excavation (prism)—	
Construction work	11,485,691.75
Plant	637,027.88
Pedro Miguel Locks and Dams—	
Construction work	13,441,556.31
Plant	24,123.65
Miraflores Locks and Dams—	
Construction work	21,797,177.67
Plant	[1] 23,495.58
Rock and sand account—	
Ancon rock plant	[1] 24,417.18
Chame sand plant	[1] 7,724.95
Miraflores power plant, construction work	208,609.96
Naos Island Breakwater, construction work	851,338.19
Terminal facilities, Balboa—	
Construction work	7,264,838.59
Plant	134,175.77
Total, Pacific district	59,206,213.64

[1] Credit.

TABLE D.—DETAILED STATEMENT OF CLASSIFIED EXPENDITURES FROM THE BEGINNING OF THE WORK TO DATE—Continued.

	Total to June 30, 1914.
General:	
Aids to navigation—	
Construction work	$560,666.52
Plant	30,941.27
Permanent town sites, construction work	720,624.39
Permanent buildings—	
Construction work	1,590,252.30
Plant	21,349.06
Electric transmission line—	
Construction work	1,916,383.43
Plant	752.36
Permanent oil pipe line, construction	....
Total, general	4,840,969.33
General items:	
Hotels, messes and kitchens, operations	[1] 104,232.32
Hotel equipment	61,146.63
Hotel, incidental expenses	51,917.12
Hotel Tivoli	[1] 175,577.55
Hotels, messes and kitchens, alterations and improvements	141,509.58
Lands purchased—	
For construction work or to be flooded	552,624.98
For other purposes	312,141.93
Joint land commission	343,844.70
Cristobal terminals—	
Docks and wharves	282,595.06
Dredging	84,778.74
Balboa terminals, docks and wharves	160,887.07
Panama R. R. second main track	1,123,522.22
Relocation of Panama R. R.—	
Construction work	8,942,372.37
Maintenance	118,200.75
Plant	210,606.28
Purchase, improvement, and repair of steamers—	
Panama	655,942.48
Colon	579,812.22
Cristobal	716,085.43
Ancon	728,271.88
Construction of buildings, department of construction and engineering	9,611,827.29
Alteration and repair of buildings, department of construction and engineering	783,490.73
Purchase from New Panama Canal Co	40,000,000.00
Payment to Republic of Panama	10,000,000.00
Loans to Panama R. R. Co	3,247,332.11
Purchase of Panama R. R. stock	157,118.24
Construction of waterworks and sewers—	
Panama	682,563.28
Colon	616,268.99
Zone waterworks and sewers, construction—	
Zone proper	3,376,001.79
Panama system	490,073.45
Colon system	644,364.89
Ancon filtration plant	19,816.33
Permanent supply	776,857.30
Maintenance	1,585,635.68
Paving Panama	577,718.28
Paving Colon	534,938.72
Zone roadways—	
Construction work	1,438,798.79
Repairs and maintenance	261,482.83
Miscellaneous grading and other municipal work	4,142.62
Moving and care of French material and equipment	2,833.23
Plant in Panama R. R. service	789,506.65
Permanent plant	36,987.66
Total, general items	90,374,263.38
Fortifications:	
Atlantic—	
Seacoast batteries, emplacement	1,612,841.96
Fire control	213.98
Submarine mines structures	116,184.79
Plant	10,806.27
Total, Atlantic fortifications	1,740,047.00

[1] Credit.

TABLE D.—DETAILED STATEMENT OF CLASSIFIED EXPENDITURES FROM THE BEGINNING OF THE WORK TO DATE—Continued.

	Total to June 30, 1914.
Fortifications—Continued.	
Pacific—	
Seacoast batteries, emplacement	$1,986,687.25
Power plants	15,260.01
Searchlights	61.65
Fire control	4,763.56
Submarine mines structures	78,836.97
Causeway	64,699.01
Plant	8,207.72
Total, Pacific fortifications	2,158,516.17
Land defenses and barracks—	
Surveys	46,069.10
Field fortifications and camps	196,450.79
Total, land defenses and barracks	242,519.89
Guns and ammunition—	
Armaments to fortifications	2,596,745.72
Ammunition	903.62
Submarine mines material	54,357.33
Total, guns and ammunition	2,652,006.67
Total, fortifications	6,793,089.73
Grand total	[1] 332,939,626.28

[1] To which should be added the appropriation, 1899, $1,000,000, for Isthmian Canal Commission No. 1.

Aqueducts. (See Bridges.)

Arches. (See Standards.)
Center wall, Pedro Miguel Lock. **P-11**, 192, pl. 46.
Standard concrete culverts, Panama R. R. **P-09**, 142, pl. 73.

Architect.
Office of. **P-09**, 150.

1913. Architectural force organized under Mr. Austin W. Lord, architect, July 1, 1912, to draw up plans of administration building, a general scheme for establishment of new town to be created at Balboa, near Pacific entrance of canal, and prepare designs for houses for permanent operating force. **P-13**, 2.

1914. A force under a landscape architect was gathered together to lay out the grounds and construct streets, water, and sewer systems for the Balboa town site, independent of the division of municipal engineering. **P-14**, 1, 2.

Architecture and Building. (See No. 243, p. 2367 of this Index.)
Bureau of, established. **P-05**, 130.
Status of bureau work, July 1, 1905. **P-05**, 135.

Arms, Fire.
Executive order. **P-14**, 562.

Army.
Compensation of men and officers of, retired. **P-11**, 573.

Army and Navy.
Purchases from persons in; Executive order. **P-12**, 612.

Arrests. (See Civil administration.)

Artesian Conditions.
Gatun Dam studies. **P-08**, 182.

Artesian Well. (See Well, Artesian.)

Asphalt, Concrete.
Mixing plant, and road making, Balboa. **P-14**, pls. 29, 30.

Assets.
Isthmian Canal Commission No. 3; statement. **P-05**, 21.

Assistants, Chief Engineer. (See Nos. 243 and 244, p. 2367 of this Index.)

Asylum. (See Lepers.)

Athletics. (See Recreation.)

Atlantic Division. (See No. 240, p. 2367 of this Index.)

1909. Gatun Locks, excavation: Steam shovels and a suction dredge at work; 933,546 c. y. in the dry and 479,950 c. y. in the wet removed; trenching for curtain walls in progress at end of year.

Foundations: Tests have proved that the soft sandstone has sufficient resistance to bear safely the greatest loads that will be brought on it by the structures. Curtain walls to prevent any underflow. Holding qualities of sandstone tested by application of power to pull out French rails embedded or anchored into it; result, decided to give thickness of 13′ to the concrete floor of the locks between the upper miter sill and the sill for the intermediate gates, and to use old French rails on hand for the anchorages. Rails being placed. Sumps also planned with telltales. In the forebay between the sill for the emergency dam and the first miter sill of the lock a 20′ thickness of concrete has been adopted for the floor.

Plant, lock construction: Installed. Sand, stone, cement, to be brought in barges up the French canal to unloading docks on either side of the east division, to which a channel has been dredged. Cement shed with capacity of 100,000 barrels. Electric cranes used. Sand and stone barges tie up at west dock; unloaded with single and duplex cableways on towers; materials transported thus to stock piles with capacity of about 200,000 c. y. stone, and 100,000 c. y. sand.

Concrete mixing and placing: Electric railway from piles to cement shed, thence to mixers; automatic cars; cableways convey to deposit point; forms of steel.

Power, electric: Plant located in a temporary house, to be moved finally to spillway.

Porto Bello quarry: Plant installed for crushing stone. Machine shop equipped. Expected that plant will furnish 2,400 c. y. daily.

Sand supply: Nombre de Dios the source selected. Arrangements made for water-supply, and for accommodations of employees. Dredging to secure safe harbor, and channel to sand deposits; sand dredged and sent to Gatun for concrete needed in spillway construction. Clamshell dredge to be used; under construction.

Transportation plant: 3 tugs and 14 barges, each with a capacity of 600 c. y., provided for transporting sand and stone to Gatun. **P–09,** 3, 4.

Gatun Dam, plan: Cross section changed, as noted in 1907 report, to make slopes flatter. Dam to be construteted of 2 rock piles 1,200′ apart, and made of spoil from Culebra Cut, lock site, and excavation for the spillway, between which piles selected material to be deposited hydraulically, forming impervious part of the dam.

Operations: Work on south rock pile done until it reached approximate elevation of 58′ crossing the Chagres River and the French canal. Before north pile was started a suction dredge removed deposits accumulated in the Chagres River over the 1,200′ length, and also over same distance in the French canal; this done, the north rock pile was started across the channels, and water areas thus inclosed were pumped out, sheet piling up to sea level permitting the accomplishment of this.

Slip, notable: When the water level in the French canal had been reduced to −10′, on Nov. 20, 1908, a slip of a portion of the south toe occurred at the intersection of the rock pile and the east bank of the French canal. The depression in the crest was about 20′; length affected, 200′; a track on the north slope at about elevation 30 moved northward about 10′; the track on the south side, however, at about the same elevation was undisturbed. "The slip was of no more significance than those which had occurred on the railroad embankment in the vicinity of Gatun."

Special examination of dam, etc.: Because of a feeling of uneasiness in the U. S. concerning what the aforesaid slip suggested, the President sent the Hon. W. H. Taft (President-elect), with Engineers F. P. Stearns, A. P. Davis, H. A. Allen, J. D. Schuyler, I. Randolph, J. R. Freeman, and Allen Hazen, to report upon the matter. Plan for dam with uniform slopes to top submitted to them, placed at 105′ above sea level. Reported there would be no seepage, that materials to be used would make a tight, stable, and permanent dam; that type of dam had unanimous approval; that dam more than a third of a mile in horizontal thickness at its base, and "the design upon which the work is now being prosecuted abundantly fulfills the required degree of stability, and goes far beyond the limits of what would be regarded as sufficient and safe in any less important structure"; could readily understand "how incorrect deductions may have been drawn from these occurrences" (slips of material piled at a steeper slope than would ultimately be the case); considered properheight for the crest, and concluded it could be safely reduced 20′; of opinion that the sheet piling proposed under the base of the dam could be safely omitted; recommended continuation of narrow cut-off trench to be filled with sluiced material, through upper earth stratum; changes thus proposed would facilitate work of construction and reduce cost; "a full study of all the data at hand and of the materials, and of the plans that are proposed with the above modifications leaves no doubt in our minds as to the safe, tight, and durable character of the Gatun Dam."

Dam construction: South rock fill raised to elevation 58; from this elevation material was so dumped on the upstream side as to secure the proper slope. West of the spillway spoil from various sources was dumped east of the west diversion through which the Chagres discharges up to reference 24. Embankment inside north rock toe carried up to plus 35 east of the spillway; at the close of the year three 20″ suction dredges depositing material over area between rock piles, which had been cleared of all vegetation and trenched to make proper bond; this fill had reached average elevation of plus 16. Total of 2,501,372 c. y. placed in dam during year. P-09, 6, 7, 8.

Excavation, through Spillway Hill, practically completed.

Gatun Lake, beginning of: Concrete floor below area to be occupied by the dam laid. As soon as side walls and floor are finished, and provisions made for construction of concrete dam, earth dam can be carried across west diversion. This will cause the river to discharge through the spillway channel. Closing the diversion will be the first step toward the formation of the Gatun Lake, the rising level of which will be subject to control by means of culverts with valves placed at a low level in the spillway dam.

Spillway: The concrete channel below the dam is 960′ long and 285′ wide between the walls. Floor varies in thickness from 1′ at the lower extremity to 4′ near the dam; side walls will average 27′ in height. Sand and stone brought from Nombre de Dios and Porto Bello to temporary dock on the French canal below the dam, where two 2-yard mixers were installed. Concrete taken to site by narrow-gauge road; average length of haul, 4,520′. Floor slopes from elevation 10 to elevation 2.2; laid in monoliths 30′ by 20′. Side walls in 35′ sections. Regulating works will permit discharge of 140,000 cu. ft. per second, when surface of lake is at plus 87.

During year 359,821 c. y. removed from Spillway Hill, and placed on dam. There were laid, also, 30,464 c. y. concrete.

Mindi Hills section: Excavation started by steam shovels; expected that when shovels reached sea level dredges would have to continue the work because of the French canal being so close to the area, and the Mindi River also. Found that small dike and clay overlay were good protection against seepage. Excavation in dry continued. One shovel at 32′ below sea level, or 9′ above bottom line. Floods pumped out. Total amount removed during the year, 615,146 c. y., of which 448,287 rock.

Mindi to deep water: Dredging fleet (1 seagoing suction dredge, two 5-yard dippers, and 3 French ladder dredges) removed a total of 6,039,934 c. y. (427,005 c. y. being rock).

Rock blasted: Holes averaging 15′ apart churned to 50′ below sea level; loaded with dynamite.

At close of year nearly 3 miles of channel (41′) completed.

Dredging done also in connection with other work, amounting to 155,073 c. y. and 49,669 c. y. rock.

Limon Bay Breakwaters: Breakwaters parallel to the axis of the channel proposed by Board of Consulting Engineers (1906), for protection against northers and filling of channel. Plans changed to gain dissipation of entering waves, etc.

Plans and estimates prepared for 2 breakwaters; 1 about 10,000′ long from Point Toro in a general northeasterly direction, and the other about 3,500′ long running out from Mansanillo Bay, in a northwesterly direction. Exact location of the works to depend on investgations in progress. West one to be built first; easterly one may not have to be built; future to determine.

Marine shops at Cristobal added to and partly enlarged. Great amount of work done. P-09, 8, 9.

Municipal building and sanitary work—Gatun water supply: Existing source the Gatun River; supply never satisfactory; formation of Gatun Lake, etc., makes necessary a new source of supply; to be obtained from storage reservoir created by a dam across the Agua Clara Creek, east of the new village of Gatun.

Reservoir dam: Rock and earth fill, with a concrete wall. Capacity behind it of 612,000,000 gallons. Work on it begun.

Roads: Road from Gatun to Mount Hope continued. Considerable street, road, and sewer work done, particularly in new village of New Gatun.

Buildings: 33 of various kinds built.

Sanitary work: Regrading, cleaning, and widening of ditches. P-09, 9, 10.

1910. William L. Sibert, Corps of Engineers, U. S. Army, as division engineer.

Gatun Locks: Excavating locks continued by steam shovels, and by dredges, resulting in removal in lock chambers of 3,965,699 c. y. in the dry and 435,178 c. y. in the wet. In addition, 646,520 c. y. of material removed in auxiliary work, including dredging in French canal. Excavation in upper locks completed, including trenching for curtain walls and for lateral culverts. With exception of some trenching, excavation for intermediate locks completed. Excavation for lower locks undertaken; 375,000 c. y. remain to be removed. In preparing foundations for concrete, including excavation for trenches for lateral culverts, 33,843 c. y. removed during past 6 months. Anchorages in upper locks for tying concrete to natural rock completed, as well as the filling of curtain wall trenches around upper part of upper locks.

At close of 1909 unloading cableways in partial operation. Entire plant completed in time to permit laying of concrete Aug. 24.

Unsatisfactory operation during early stages of their use resulted in construction of additional unloading plant, consisting of sand bin having capacity of 200 c. y., so arranged as to feed into automatic cars, and 2 rock bins having capacities of 300 and 200 c. y.; derricks were erected for unloading sand and rock from barges. These supplemented by stiff-leg derrick erected at Mindi, with docking facilities, for unloading sand and stone from barges to cars; when floods in Nov. prevented use of French canal by tugs and barges, arrangements made for unloading barges at Dock 13, using locomotive crane. Mindi plant in service Nov. to June, and plant at Dock 13 from Dec. to Apr. To deliver material unloaded by these plant additions to stock pile, and to unload in stock pile sand from Pacific division, a trestle 179′ long constructed over east sand tunnel.

Unloading plant operated 24 hours per day since Apr., when searchlights were installed. Material handled, 2,458 c. y. large rock, 358,665 c. y. crushed stone, and 155,458 c. y. sand; unloading cableways handled 314,854 c. y. crushed stone and 138,813 c. y. sand.

Cement deliveries by Atlas Portland Cement Co. commenced July, 1909, and with cement shed full, the difficulties met with in operation of plant caused supply to accumulate faster than could be used. Rather than stop deliveries, instructions issued to lay as much concrete as possible, and for erection of auxiliary plant. Work was prosecuted daily, including Sundays, until Nov., when Sunday work discontinued. On Sept. 6 a 12-hour day for permanent plant instituted, and continued throughout the year.

Auxiliary plant, two 2-yard mixers similar to those used in the permanent plant, began operations Dec.; continued on basis of 8-hour day.

Permanent plant laid 409,381 c. y., including large rock placed in concrete, and auxiliary plant, 104,422 c. y.; total, 513,803 c. y. Of total amount of concrete to be placed in Gatun Locks, including the approach and wing walls, amount remaining is 1,532,297 c. y.

Average cost of the concrete per yard in place for the year was $7.355, including plant.

With view to reducing cost of concrete, instructions issued Nov. to embed large stone in concrete to about 20 per cent of mass; up to close of year aggregated a total of 10,786 c. y. Stone selected from material shipped from central division for toes of the dam, and 2,458 c. y. of large stone procured from Porto Bello quarry in May and June. On account of excessive cost of the latter, $6.284 per c. y. delivered at locks, this source of supply abandoned.

Collapsible steel forms used throughout for main and lateral culverts, and steel tower forms used for side and center walls.

Difficulty experienced in handling water as excavation of lock increased; during heavy rains in Nov. and Dec., 1909, pumps unable to keep down inflow. Two additional 12-inch pumps ordered.

Foundation for 150′ of south approach wall put in. To the south of this section the ground is low, requiring a fill; about 90 per cent of this work completed.

Stone and sand: Crushed stone for concrete of locks and spillway obtained from Porto Bello quarry, which was developed during year with single face length of 2,500′ and height of 140′. To overcome delays, and to increase output, a No. 21 crusher ordered in Nov.; under erection; 12-hour working day increased to 16 hours Dec. 27 by operating two 8-hour shifts; continued during remainder of year.

Total amount quarried and crushed, 549,678 c.y.

New pressure pump installed and pipe line laid for doing the necessary stripping by hydraulic process. Two boilers, a dynamo, engine, and condenser were also installed. Wireless station erected and clubhouse and commissary building constructed.

Sand obtained from Nombre de Dios and from Pacific division. On Apr. 8 fire destroyed 73 buildings; replaced by new buildings in rear of Nombre de Dios. Dredge "Nombre" sank in Sept. and raised in Nov.; converted into 12-inch pipe-line dredge; began pumping Mar. 1, moving toward deposits in the town. In addition, sand obtained by clamshell dredge temporarily mounted on a barge, by locomotive crane, and by dipper dredge "Chagres" operating until removed to Limon Bay in Dec. Total sand obtained from Nombre de Dios, 187,183 c. y. During year, 101,748 c. y. transported from Balboa docks in Pacific division and delivered in stock pile at Gatun.

For transportation of sand, stone, and cement, 3 tugs, 1 stern-wheel towboat, and 14 barges in use. Four additional barges under contract.

Gatun Dam: Prior to Jan., 1910, operations in construction of dam practically limited to portion between locks and Spillway Hill. Decided in Jan. that larger amount of material for toes should be procured from central division. Additional steel dump cars ordered.

Discharge of Chagres River through west diversion continued until Apr. 25, when work in spillway had been advanced to permit its use for this discharge. Efforts then concentrated toward filling in toes crossing west diversion. Some minor slips; none of importance.

At close of fiscal year, the north and south toes of dam east of Spillway Hill had reached 65′ above mean tide, and hydraulic fill between the toes 51′. West of Spillway Hill the north toe carried to plus 30, and south toe to plus 35. Three dredges were pumping hydraulic fill into the west section, 2 from south side and 1 from north, and a fourth dredge was put, June 28, on east portion of the dam. Total amount placed in dam during fiscal year, dry fill 2,577,234 c. y., hydraulic fill 2,933,175 c. y.

Auxiliary work consisted in preparing west valley for reception of hydraulic material by clearing and stripping off top soil containing roots, excavating cut-off trench along axis 10′ wide and 5 to 10′ deep, and a bonding ditch along foot of western ridge. Surface of low-lying areas plowed. Preparatory work required excavation of about 112,000 c. y. over area of 62 acres. Area of 138.45 acres south of dam over which dredges will operate in securing interior fill thoroughly cleared and grubbed. Area of 51.36 acres to north of dam cleared for same purpose. 7,486′ trestles constructed during year.

Excavation for spillway continued during the year, removing 127,210 c. y. Excavation for foundation of spillway dam completed, except at extreme end; that for curtain, side walls, and floor fully completed. Work on floor and side walls continued; 53,632 c. y. concrete placed, at average cost for last 6 months of the year of $8.602 per c. y. By Apr. 25 side walls, floor, and curtain walls completed, and foundation of dam sufficiently advanced to warrant turning Chagres River through spillway. Time lost owing to excessive floods, Nov. and Dec. As foundations of dam placed at elevation plus 10, and other channels of the river cut off, lake has been backed up so that its surface stands at from 16 to 20′ above sea level.

Material carried to toes on west portion of dam by trestles in prolongation of toes, across channel through the spillway; as trestles are liable to be carried out during flood season, a permanent bridge across spillway constructed, consisting of 6 spans on concrete piers.

Chagres River passing through west diversion had access to the French canal, and silting resulted; necessity for closing passage; failure to do so before high water of Nov., 1909, caused considerable silting of French canal and main channel in Limon Bay, and interfered seriously with movement of sand and stone to Gatun. Dec. flood took out what was accomplished on the dam or levee in interval between floods. Work finally undertaken in Mar.; plan contemplates levee connecting Spillway Hill with Mindi Hills, having elevation of plus 25 at spillway, and sloping to plus 21 in a mile; length to be 1½ miles; 126,000 c. y. of material placed.

Channel between Gatun Locks and the Atlantic Ocean: Excavation in the dry in Mindi section continued until Nov. 20, when work was suspended due to the cut being filled by high water in Chagres River, which had access to French canal. There were excavated in the dry 91,572 c. y. earth, and 233,144 c. y. rock. Deepest part of cut had reached 42′ depth below sea level at time work was suspended.

Dredges in operations between Mindi Hills and Caribbean consisted of 20-inch suction seagoing dredge "Caribbean"; 5-yard dipper dredge "Mindi"; three French ladder dredges, and dipper dredge "Chagres." Dredges removed 4,556,375 c. y. of earth and 399,285 c. y. of rock from canal prism, at average cost of 23.60 c. per c. y. There were also handled 3,206 c. y. of earth from approaches to Gatun locks, and 69,844 c. y. of earth and 55,036 c. y. of rock from French canal. Dredges also removed total of 247,537 c. y. of earth and rock from Cristobal terminals, and 501,928 c. y. of earth and rock from approach channel leading from canal to Cristobal Harbor. Total silting between miles 1 and 2, 493,365 c. y., and fill for the year in mile 3 amounted to 461,922 c. y.; total fill during year estimated at 3,500,000 c. y., of which 550,000 c. y. resulted from Chagres River flood in Nov., 1909.

An old French hull, overhauled and fitted with 8 Star well drills, was worked successfully on subaqueous drilling. Dry-dock shops enlarged to provide for installation of additional machines, and the fleet of dredges, barges, and tugs in charge of the Atlantic division was maintained.

Breakwater: The location of west breakwater for protection of Limon Bay and canal channel through these waters definitely fixed Mar. 10, 1910, after examinations by soundings and borings covering extended area. Plan originally contemplated breakwater running out to a 44′ depth. Decided to adopt the plan, because sufficient protected area beyond 40′ contour would be obtained, and because of economy.

Preliminary work toward laying of tracks, clearing land, construction of quarters, and establishment of permanent water supply undertaken preparatory to construction of trestle for actual work of building the breakwater.

Municipal improvements: Construction of the Agua Clara Reservoir, with exception of filter plant, continued; completed during year at total cost of $202,147.05, exclusive of the filters. Pumping station on Gatun River in operation until May 28, 1910, when supply was furnished from new system. New village of Gatun supplied with water from new system, and about two-thirds of water service required completed.

Sewer system for New Gatun completed, and progress made toward installation of plumbing.

Mount Hope-Gatun road completed. Road fenced on both sides from Mount Hope to Mindi, 5½ miles. Additional roads constructed about Gatun facilitate access to commissary and corral.

Condition of water in reservoir at Brazos Brook excellent. Owing to slight settlement of dam and dikes, they were raised to elevation 55, 1,715 c. y. of earth being required. Repairs made to concrete apron under 48′ waste pipe.

To prevent erosion of beach at Cristobal by wave action from Limon Bay, 173 concrete blocks made and placed in line along beach.

Municipal improvements undertaken in Colon.

Sanitary work consisted of constructing new drainage ditch 500′ long; on an average 8,200′ of ditch regraded, cleaned, and widened each month. **P-10,** 6-14.

1911. Gatun Locks: During year excavation of lower lock practically completed to include location of caisson sills. 475,875 c. y. removed by steam shovels. Original estimated amount increased by reason of slides in lower lock, especially on east side, and at north end of east side wall it was necessary to go to 66′ below sea level to secure suitable foundation. Excavation to north of caisson sills will be done by dredges; to prevent water from flooding lock while excavation in progress, concrete dam 50′ high projected, at estimated cost of $30,000 for construction and removal. In preparation of foundations for locks there were removed by shovel, crane, and hand 152,582 c. y.

Construction plant modified by changing automatic railroad from third-rail system to trolley system, resulting in more satisfactory service. The sand bin was taken down and rebuilt farther to the north on same level with stone bins previously erected. Derricks which had been used for unloading at Mindi moved about Jan. 1 to vicinity of cement shed. Erection of additional derrick, making 5 derricks, all told, and rock screen completed Feb., and used for supplying screened stone for reinforced concrete work and for making concrete piles. Auxiliary plant continued in use at original location, but part of narrow-gauge equipment, formerly operated in connection therewith, employed in carrying concrete supplied by permanent plant through chutes to places in the floors and walls where concrete was required.

During year the unloading cables were operated for 24 hours per day, except Sundays; handled 500,550 c. y. of crushed stone and 241,858 c. y. sand. Material handled during year by average of 3.93 derricks, operated on an average of 19.12 hours per day, was 294,665 c. y. of crushed stone and 166,606 c. y. of sand; a total of 461,271 c. y. Major portion of material unloaded by derricks was used at auxiliary plant. Derrick and rock screen furnished 2,003 c. y.

During year 945,525 barrels cement received into storehouse; in May, 1911, bags substituted for barrels. During year an average of 6.06 of the eight 2-yard mixers installed in the construction plant furnished 602,851 c. y. of concrete. Two auxiliary plant mixers operated on average of 9 hours a day, except between Sept. 21 and Nov. 5, 1910, when they operated on 12-hour basis, and mixed 226,476 c. y. Four ⅓-yard mixers purchased and, together with small amount mixed by hand, produced 10,175 c. y.

Product of construction plant mixers was placed by cableways or transferred by chutes to narrow-gauge equipment, from which the concrete was dumped in place. Cableways operated 12 hours per day, handling 616,661 c. y. concrete and large rock. Narrow-gauge equipment handled 286,265 c. y. concrete and large stone. Total masonry (concrete and large stone) laid by construction plant, auxiliary plant, portable mixers, and hand aggregated 911,137 c. y. Stone laid in concrete selected from material taken to Gatun from Culebra Cut. On basis of estimated amount of concrete required in Gatun Locks, 2,085,000 c. y. masonry work at close of year 68.34 per cent completed.

Backfilling in rear of side walls of all the locks partly placed during year, that for east side of upper lock being completed sufficiently to form storage yard required by gate contractor. Backfilling to amount of 535,669 c. y. accomplished during year; 2,717 c. y. filling were placed in center wall. Ground adjacent to lower locks lower than walls and slopes toward the north so as to necessitate trestles for carrying cableway tracks; these have been built; will be utilized in making fill in rear of lock walls. To protect lock pit against material sliding into it, toe wall constructed along east side and backfilled.

Arrangements made for construction of concrete piles for foundations for upper or south middle approach wall; to be driven into fill, which was partly completed at beginning of fiscal year, extending out to intersection of center line of locks with old east diversion channel; fill completed. 31,060′ of piling constructed of improvised reinforcement and 8,196′ driven. Sand obtained from Pacific division. Owing to difficulties experienced with longer piles, substitution of creosoted for concrete piling under consideration.

Stone and sand: Crushed stone for concrete locks and spillway obtained from Porto Bello quarry. The single face which had been developed during previous fiscal year increased, with result that its length was 2,600′ and maximum height 170′. Shortly after plant was placed in operation, Mar. 2, 1909, it was manifest that the largest crushers, No. 9, could not economically perform work because of difficulty and expense in reducing stone to proper size. A No. 21 crusher, ordered Nov., 1909, installed and put into operation Sept. 4, 1910. Difficulties experienced with the pan conveyors were remedied after they were remodeled and laid on heavier tracks. Larger crusher receives stone of maximum size handled by steam shovels. Changes resulted in increasing capacity of plant and reducing cost of production. Stone crushed during year, 864,033 c. y. Up to Sept. 17, quarry operated on basis of 2 shifts, or 16 hours per day, on which date 12-hour day adopted and continued until Jan. 16, when working day was reduced to 10 hours, and on Feb 15 normal working day of 8 hours adopted. Material transported to Gatun in barges, whence transferred to stock piles. Porto Bello quarry also to supply rock needed for outer stone or armor of breakwater at Toro Pt. Necessary plant for this purpose ordered and wharf at Porto Bello under construction.

Sand obtained from Nombre de Dios by means of 2 cranes and 3 dredges, and from Pacific division. At Nombre de Dios the sand procured from channel and from area occupied by buildings destroyed by fire of Apr. 8, 1910. Buildings replaced in rear of town at cost of

$9,555.05. Cranes and rolling stock removed in May. Sand obtained, 441,919 c. y., transported in barges to Gatun, whence transferred to stock piles. Pacific division furnished 17,319 c. y. sand.

For transportation of sand, stone, and cement 4 tugs, with occasional service of a fifth, 1 stern-wheel towboat, and 18 barges in use; 4 additional barges received.

Gatun Dam: At beginning of year north and south dry fills of east portion of dam, extending from locks to spillway, had reached 65′ above mean tide, and hydraulic or impervious portion between them carried to 51′. At close of year the dry fills raised to 85′ and hydraulic fill to plus 73. On July 1, 1910, north and south dry fills of portion on west side of spillway were at 30 and 35′, respectively, and intermediate hydraulic material at plus 16; material added during year to make elevations at close of year plus 60, plus 67, and plus 57.3, respectively. In securing this increase in elevation of earth portion of dam cross sections show 2,060,186 c. y. dry material placed in structure; also, that dredges delivered into interior portion of dam 3,758,870 c. y. In other words, total increase during year was 5,819,056 c. y.

Amounts of material noted as resulting from cross-section measurements of June 30, 1910, and June 30, 1911, differ from aggregate amounts reported monthly as having been placed in the dam, and on which the unit costs are computed, by 1,109,619 c. y. Based on monthly reports of materials placed in the dam, the cost for year averaged $0.3813 per c. y. for dry fill and $0.2289 per c. y. for wet fill. The increase between these costs and those that necessarily result from the decrease in quantities shown by the cross sections will be accounted for in determining final cost of the work.

New trestle built across spillway channel at elevation 45 to give easier access to dry fill of west portion of dam, and also to replace old one in bad condition. To handle expeditiously and economically increased supply of material from Culebra Cut permitted by additional cars, an extension of track system made; at close of year there were 21 miles of tracks connected with construction of dam and auxiliary works.

Material for dry fill obtained from Culebra Cut, from lock site, from Mindi, from spillway, and from borrow pit below or north of the dam; based on car measurements, the quantities from each locality amounted to 2,065,272, 320,599, 8,179, and 332,044 c. y., respectively. Service from Culebra interrupted for 1 week during Dec. flood.

Hydraulic fill obtained from above and below dam and placed by 5 suction dredges, 3 of them operating practically throughout the year, 1 operating for 4 months, and the other for over 2 months. From Sept. 16 to Nov. 11 hydraulic filling of east section suspended to enable concentration of available dredges on west portion of dam, to bring fill up to plus 30 before flood periods, and to permit drying out of east part of dam. From Jan. 1 to Apr. 15 pumping into east portion discontinued to determine to what extent hydraulic fill would dry out and solidify. Tests showed greater solidity on north side of fill and when operations were resumed more of sandy material was pumped along opposite side. While gradual solidification took place during dry season, central portion showed little change; unless this soft material is crowded out during subsequent construction, or hardened by addition of more sandy material, part of fill must be drained off after full height is reached.

In addition to maintenance of tracks, miscellaneous work consisted of installation of pipes, including trestles therefor from dredges to relays, of which 4 were in operation, and from relays to various points along length of dam for delivery of hydraulic fill; laying pipes for draining water and finer material from fills; stripping and spading up subsoil in advance of hydraulic fill; and clearing ahead of dredges.

Based on the estimated amount of material needed in construction of dam, it is 74 per cent completed.

In the construction of spillway, work confined to excavation necessary for east and west approach walls and in forebay. During year concrete work on forebay below reference 45 completed, and approach walls with projections or cores to tie earth portion of dam with spillway completed to elevation 95 for straight horizontal portions and slopes to south. During dry season, after discharge from lake had diminished, construction and sluicing piers begun and carried to 45′ above sea level; balanced valve and 3 sluice-gate frames set; cofferdams built on both sides of channel below spillway dam, and foundations prepared and concrete placed to build sufficient of ogee of dam to bring it above high water. Subsequently 2 additional small cofferdams constructed for placing concrete of dam just outside channel flow. After beginning of wet season construction of side sections of dam and of side approach walls continued. Excavated during year, 125,383 c. y., practically completing this part of work. In preparing foundations, 32,245 c. y. material removed. Concrete placed during year, 59,651 c. y. Concrete portion 66 per cent completed. Tracks laid and back fill begun behind side walls of channel below dam. Total back fill at spillway during year aggregated 12,873 c. y.

Levee connecting Spillway Hill with Mindi Hill completed in accordance with approved plan. 51,156 c. y. dry fill placed, and suction dredge placed 20,398 c. y. of hydraulic fill in old Chagres River bed east of levee.

Channel between Gatun Locks and Atlantic Ocean: To north of locks and between them and Mindi Hills 20″ suction dredge removed

423,427 c. y. from canal prism, pumping material into swamp areas to east.

Excavation through Mindi Hills flooded, as noted in last annual report; no work done until Oct., 1910, when suction dredge began to cut way from French canal into cut through barrier which had been left to exclude the water so that excavation could be done by steam shovels. Soft material had been deposited by floods; clay moved into cut by slides removed by hydraulic dredge and deposited in swamps to east of canal line; total amount handled, 401,511 c. y. After the removal of dredge in Jan., opening in barrier closed and cut freed from water by pumping. Steam-shovel work resumed Feb. 1 and carried on balance of year, removing 53,199 c. y. earth and 227,106 c. y. rock. Of material excavated, 165,000 c. y. rock used for back fill behind lock walls; balance utilized in filling trestle constructed east of Panama R. R. relocation between Mindi and New Gatun, forming levee behind which it is proposed to pump material excavated between Gatun Locks and Mindi with suction dredges. In construction of levee, 5,650 lineal feet of trestle built and filled. In addition to material obtained from excavation at Mindi, part of material removed from lock pits utilized.

Dredges which operated between Mindi Hills and deep water in Caribbean in excavating canal prism were seagoing dredge "Caribbean," 5-yard dipper dredges "Chagres" and "Mindi," and three French ladder dredges. These removed 4,516,369 c. y. earth and 487,038 c. y. rock, at cost of $0.2215 per c. y. Silt deposited in channel during year, 2,750,000 c. y.; first 2 miles of channel surveys, June, 1910, and June, 1911, showed silting of 310,901 c. y.; in mile 3 silting was 902,038 c. y.; surveys made immediately after norther of Dec. 3 to 5, inclusive, showed fill of about 370,000 c. y. In addition to dredging in prism, 442,350 c. y. earth and 4,853 c. y. rock removed from channel in front of piers 11 to 14, inclusive. Miscellaneous dredging in vicinity of dry-dock slip, Shelter Cove, in French canal, and in front of cement dock at Gatun, aggregated 51,636 c. y. earth and 18,886 c. y. rock.

At dry-dock shops, boiler-shop extension completed, the necessary jib and traveling cranes erected, condenser installed, and oil forge added. These shops maintain fleet of dredges, barges, and tugs in charge of Atlantic division.

Breakwater: Preparations made so that active operations in construction of breakwater leading out from Toro Pt. could be undertaken at beginning of fiscal year. Necessary buildings constructed, machines installed in shop erected for repair work, and construction material collected and stored. Reservoir constructed for water supply, necessitating dams which contain 54,390 c. y. of material; necessary pipe lines laid. Trestle for breakwater started Aug. 9, 1910. Steam shovel began work in Sept., and a second one in Oct. At end of year 5,365 lineal feet double-track trestle completed, and 359,890 c. y. fill dumped from trestle. In addition, 619,152 c. y. rock dredged from prism dumped in vicinity of breakwater.

Municipal improvements: Rapid gravity mechanical filter plant authorized for Agua Clara Reservoir in Jan. at estimated cost of $37,447. At close of year 94 per cent of concrete work completed, and filter plant as a whole 80 per cent completed.

Sewers extended 4,425′, and usual maintenance work in connection with sewage system carried on.

16′ macadam road built from incinerator to New Gatun, 1,400′; 12′ road, 650′ long, constructed from corral to lumber yard for fire protection, and 101′ of road entering corral rebuilt. 3,100′ of curb and gutter constructed along streets in Gatun. In addition, municipal improvements carried on in Colon.

Sanitary work consisted of cleaning and grading 197,834′ of ditches and cleaning 29,160′ of road ditches. **P-11, 6-14.**

1912. At close of previous year excavation for construction of so much of Gatun Locks as lie above lower caisson sills completed, with the exception of excavation for lateral culverts in lowest lock. This was completed during year just ended by removal of 8,888 c. y. Material to be excavated too soft to support steam shovels; recourse must be had to dredging. Suction dredge operated in area between Dec., 1908, and June, 1909, and again between Jan. 1, 1911, and Apr. 14, 1911. Nothing further done until Feb. 1, 1912, or until after completion of temporary dam mentioned in last annual report, designed to prevent water from flooding locks during excavation. This dam, completed Jan. 15, 1912, 46′ 4″ high by 200′ long, consists of series of reinforced concrete buttresses supporting timbers. Material used, 1,040 c. y. concrete and 98,736′ b. m. lumber. Amount removed by dredges, 883,918 c. y. Estimated that 89,570 c. y. will complete excavation necessary to permit unwatering of area, so that construction of wing walls and north center approach pier can begin. To secure suitable foundation, necessary to excavate in places to 70′ below sea level, which required closing opening through which dredges were admitted by an earth dam and lowering the water so that dredges could work to this depth. Material removed by dredges pumped behind levee constructed east of Panama R. R.; large portion escaped, filling Mindi River and French canal where these two cross; none reached new channel. After Mar. 31, 1912, material pumped to west of canal prism.

From July 1, 1911, cableways operated on single shift of 9 hours until June 1, 1912; subsequently occasional 12-hour shifts worked to facilitate delivery of sand from new source of supply in Chagres River. Cableways unloaded 237,750 c. y. of rock and 109,017 c. y. sand. Five derricks were in use for unloading rock and sand until Nov. 16, 1911, when the 2 sand derricks were put out of commission; remaining 3 ceased operations Apr. 29, 1912. While in service they unloaded 139,148 c. y. rock and 53,768 c. y. sand; total, 192,916 c. y. In addition to unloading, cableways also transferred rock and sand from stock piles to tunnel hoppers.

When deliveries of crushed stone from Porto Bello were stopped, the rock screen, which had been supplied by a derrick unloading directly from barges, was dismounted, placed on a car, and moved to one side of the rock-storage pile where the cableways had access to it, and since May 23, 1912, 1 duplex cableway employed exclusively with rock screen. From July 1, 1911, until Apr. 30, 1912, when delivery of cement in barges was discontinued, cement shed cranes unloaded 448,700 barrels cement. On latter date arrangements made for delivering remainder of cement in cars, to be unloaded by hand. Amount required at end of fiscal year for completing the work, in addition to that in storage, 190,000 barrels.

During year an average of 4.30 of the eight 2-yard mixers installed in construction plant furnished 343,364 c. y. concrete (bucket measurement) and were operated daily, except Sundays, on basis of 12 hours per day, July 1 to Jan. 31, 1912, and 9 hours per day from Feb. 1 to June 30, 1912. Two auxiliary plant mixers operated on average of 9 hours a day until Mar. 11, 1912, when plant was shut down and dismantled; this plant mixed 80,544 c. y. concrete during year. An average of three ½-yard mixers, together with small portion mixed by hand, produced 15,758 c. y. concrete. Product of construction-plant mixers placed by cableways, or transferred by chutes to narrow-gauge equipment, from which concrete was dumped in place. Cableways operated 12 hours a day to Jan. 31, 1912; subsequently 9-hour day used, handling 309,534 c. y. of concrete and large rock. Narrow-gauge equipment handled, in addition to large stone, 100,990 c. y. concrete from mixers and 24,434 c. y. previously handled by cableways.

Work on upper or south approach pier continued throughout year on fill reported in last annual report. For foundation of the wall 73,695 linear feet of concrete piling manufactured, at cost of $1.2156 per linear foot, and 75,474′ driven. As previously reported, difficulty experienced with longer concrete piles; 51,450′ creosoted piles substituted. Reinforced concrete construction used for south approach pier and 31,000 c. y. concrete laid in it during year, completing about 67 per cent. Guide walls at south end of locks completed and 6,000 c. y. placed for this purpose.

Total masonry—concrete and large stone—laid by concrete plant, auxiliary plant, portable mixers, and by hand, 451,025 c. y.; of this amount, 59,883 c. y. were reinforced. Of this total, 371,388 c. y. laid during 12-hour day time, so that only 79,637 c. y. laid since Jan. 31, 1912. Large stone laid in concrete, 14,194 c. y. Total concrete laid in locks to close of year, 1,875,965 c. y. On basis of 2,000,000 c. y., masonry work of Gatun Locks 93.80 per cent completed.

Slides at north end of locks continued to give trouble, interfering with extension of cableway tracks.

Back filling in rear of side walls of all locks continued. Back fill in center wall of upper and middle locks completed. Material secured from borrow pits and excavation at Mindi; 922,215 c. y. placed behind side walls, at $0.4615 per c. y. Back fill placed during year, added to that in last annual report, makes total of 1,462,074 c. y. Total fill in center wall aggregates 97,291 c. y.

Crushed stone for concrete of locks and spillway obtained from Porto Bello quarry until Apr. 30, 1912, when crusher plant shut down. Crushing plant not operated at full capacity; output limited to 3 barges per day subsequent to June 19, 1911. Total produced to shutdown, 440,413 c. y. Material transported to Gatun in barges, thence to stock piles.

Porto Bello quarry supplying rock for outer stone armor of breakwater at Toro Pt. On Aug. 18 production begun. Quarry on site lower than quarry for crushed stone, being developed in 2 benches. 1,100 linear feet of lower bench developed; length of upper one practically 1,700′. Total quarried, 65,133 c. y.

Sand was obtained from Nombre de Dios until Nov. 17, 1911, when work closed down. Total secured from July 1, 1911, to this date, 144,123 c. y. Chame sand procured from Pacific division during Jan., Feb., and Mar., when the Pacific division's equipment not sufficient to permit further shipments; 20,315 c. y. placed in stock pile from this source. Decided to use sand secured by dredge from old bed of Chagres River, and since May 15, 40,531 c. y. obtained.

For transportation of sand, stone, and cement an average of 3 tugs, including 1 stern-wheel towboat, 6 lighters, and 16 barges in use. Feb. 2, 1912, 1 tugboat and 3 barges sent around to Pacific side of canal, with intention of increasing equipment at this locality to furnish balance of sand required by Atlantic division. Tug and barges left Cristobal Feb. 11, 1912, and arrived at Balboa June 17, 1912. Sand from old Chagres River bed renders unnecessary further procurement of sand from Pacific division.

At close of previous year dry fills for east portion of Gatun Dam, extending from locks to spillway, had been raised to 85′ and hydraulic fill to 73′ above mean sea level, while north and south dry fills of portion west of spillway were at 60′ and 67′ above sea level, respectively, and hydraulic fill between the dry fills at 57.3′ above sea level. At close of fiscal year sufficient material added to raise dam length of 1,000′ east of spillway to 103.35′; for balance of portion east of spillway the dry fills had reached general elevation of 96′ and hydraulic fill between them general elevation of 85′ for portion of dam way, north and south fills had reached general elevation of 98′ and hydraulic fill elevation varying from 87′ at spillway to 78′ at drains located in northwest corner. In securing increases in elevation noted the cross sections taken June, 1912, show that dry fill was increased by 2,544,526 c. y. and hydraulic fill by 2,543,086 c. y. In obtaining this amount of 5,087,612 c. y. of net fill, 9,048,896 c. y. material were handled. For use in dry fill portions of the dam, 1,465,596 c. y. spoil obtained from central division between July 1, 1911, and Feb. 15, 1912. On the latter date old double-track line of Panama R. R. south of Gatun abandoned, necessitating reduction in number of trains per day that could be sent from Culebra Cut. Delivery of spoil from Culebra Cut stopped and borrow pits as source of supply adopted. Two to six steam shovels in these pits and in vicinity of spillway removed 1,467,675 c. y. In addition, 15,962 c. y. obtained from excavation through Mindi Hills, 62,689 c. y. from power-house excavation, and 448 c. y. from lock excavation.

Hydraulic fill was pumped into dam by 5 pipe-line dredges working in borrow pits upward of 1½ miles distant, maximum lift being 100′. One or two relay pumps were installed to assist dredges. A dredge on south side worked between Feb. 1 and July 6 pumping material along south toe of extreme western portion of dam, spreading foundation of structure to overcome slipping taking place in blanket over face of hill on west on which dam rests. It handled 582,410 c. y. A dredge on south side handled 594,495 c. y. in spreading fill made to support south approach pier of locks, which began to settle under weight of pier. Of this total, 36,000 c. y. handled in Sept., 1911; balance between Jan. 1 and May 31, 1912.

The construction of the dam proceeded in accord with recommendations or plans of 1906, 1908, and 1909, except that for construction purposes authority was given to continue the practically 1 on 8 slopes on upward, the change of slopes to be made later. Cheapest filling available that supplied by dredges; evident if this did not dry out properly a condition might arise which would result in producing such a head against dry fill that a blowout might occur. Accordingly, in Nov., 1909, instructions given to increase dry fill on both upstream and downstream sides, encroaching if necessary into hydraulic fill to secure masses such that any hydrostatic pressure produced by hydraulic fill would tend to act downward on exterior masses instead of upward and outward. Drying out tried in dry season of 1910–11 showed unsatisfactory condition regarding consolidation of at least central portion of hydraulic fill in part of dam east of spillway, but it was believed if construction proceeded along lines of the instructions given the soft material would be squeezed out as height of dam increased.

In order to determine settlement taking place in dam, observations were required on hubs located as described in last annual report and monthly record kept. Observations showed gradual settlement until on Oct. 12, 1911, a movement occurred in east half of dam. On north side, for 1,000′, top of dry fill settled 4 or 5′. This vertical movement accompanied by horizontal movement, greatest at 75′ contour, where it amounted to 14.2′, and gradually diminishing down slope to 31′ contour, where horizontal displacement about 3.2′ in length of about 700′. While the crest of the slope moved downward, lower portions of slope bulged upward to certain extent, measurements showing rise of 1.25′ on 60′ contour at point 1,150′ from center of spillway channel. Movement was within dam, as verified by test pit sunk where bulging greatest, which showed masses of dry fill desired had not been secured. Material was piled to north of 31′ contour, giving additional weight to toe, and blanket of spoil to make continuous slope from 31′ berm to top of dam placed over north face. No motion after this additional weight had been added other than gradual settlement. In addition to these steps, instructions issued to pump sand into hydraulic fill along 1,000′ length where settlement occurred at top, and to bring the dry fill up on regular slopes, gradually crowding hydraulic fill until the distance between dry fills on two sides was 25′, after which hydraulic fill to be covered with red clay and tamped wet until height of 103.35′ reached, where thickness would be 100′. Proposed to continue observations and ultimately to bring dam to 105′ above sea level and, if necessary, subsequently to raise it to height originally advocated.

Movement occurred about same time on south slope, greatest lateral motion being 6.5′ on 75′ contour. On the 60′ berm there was lateral movement of 0.5′. Heavy toe added on 60′ level, extending from dam to spillway channel wall and to berm.

In adapting cross section proposed by the board in 1909 to the ground, slopes modified where dam is practically a blanket over spur projecting from hills on west side against which dam abuts; here the plan proposed of making upstream slope 1 on 4 and downstream slope 1 on 5 was approved. As dry fill was added on upstream face of hill a condition developed indicating that material on bottom extending out from foot of hill would not bear the weight; necessary to flatten slope, which was accordingly authorized to be 1 on 7.67. Heavy fill placed on ridge that was pushed up outside of toe of this slope, and, in addition, dredge operating to south of dam extended foundation outside of rock fill by distributing material over bottom, adding to spread given foundations.

In construction of spillway, work confined during first half of year to east and west flanks, where abutments, ogee, and crest piers were completed to elevation 69, or top of dam. With the beginning of dry season about two-thirds of the central section, held at elevation 10 except for construction piers, inclosed with a cofferdam, and the concrete work carried well above water level. Full closure then made within cofferdam covering balance of central section. Three Stoney gates and one cylindrical valve installed to control flow through four undersluices. Program contemplated completion of central portion to elevation 50 by Apr. 1, so that lake could be allowed to rise to this height at dam. This done for total length, except about 120′, which remains at elevation 45, portion to be built up to required height in advance of water reaching 45′ level. Though gates controlling undersluices closed on Apr. 30 and lake allowed to rise, they were subsequently raised, as noncompletion of lock gates did not permit proposed lake level. Sluice gates raised and lowered, depending upon circumstances, until Aug. 17, 1912, when condition of lock gates was such they could be closed. On this date lake had reached 32.01′. Trestle built from eastward at elevation 95 and derrick erected near west abutment to enable construction work on east and west flanks to proceed during first half of current year. Total concrete laid, 58,666 c. y.

Plans prepared by first division O. C. E. for hydroelectric power plant, below spillway, having been approved, excavation started in May; total accomplished during the year, 72,119 c. y. During year 10,062 c. y. back fill placed about the spillway.

In channel between Gatun Locks and Atlantic Ocean excavation in dry continued through Mindi Hills and, with exception of dike separating cut from French canal, completed Feb. 24, 1912. Sluicing operations reported last year completed by removal of 1,000 c. y. mud. Two steam shovels removed 56,703 c. y. earth and 368,169 c. y. rock. When dry excavation of channel completed, barrier blown up, for which purpose 81,750 linear feet drilling done and 183,150 pounds dynamite used. Of material removed from Mindi in the dry, about 350,000 c. y. rock used for back filling at Gatun, cost of dumping being charged to locks.

Dredges which operated between Mindi Hills and deep water in the Caribbean in excavating from canal prism were seagoing dredge "Caribbean," 5-yard dipper dredges "Chagres" and "Mindi," and the French ladder dredges "No. 1" and "No. 5." They removed 3,859,445 c. y. earth and 495,595 c. y. rock. Silting during year amounted to 3,036,000 c. y., making net earth excavation in this section 823,445 c. y. Between Mindi and Gatun dredges "No. 4" and "Sandpiper" removed 515,787 c. y. earth south of old Panama R. R. line. Total dredging in prism aggregated 4,870,827 c. y. In addition, 883,918 c. y. earth and rock removed just south of locks. Miscellaneous dredging outside prism included 3,762 c. y. from dry-dock slip, 72,798 c. y. from east diversion at Gatun, 23,496 c. y. earth and 872 c. y. rock from east diversion at Mount Hope, 4,767 c. y. earth and 2,181 c. y. rock in front of dynamite dock at Mindi, 80,296 c. y. earth from pit for rock dump north of Gatun Locks, 2,785 c. y. earth from front of fortification trestle at Mindi, and 2,450 c. y. earth from slip at cable-ways. Total output for year from canal prism and lock site, 5,754,745 c. y.; and from accessory works, 444,327 c. y.

At dry-dock shops, oxyacetylene and thermit welding processes put in operation; shops maintained fleet of dredges, barges, and tugs in charge of Atlantic division.

Breakwater extending from Toro Pt. not intended to give protection against the waves produced by the trade winds, which generally are from the northeast. So far as the waves caused by the latter winds are concerned, consensus of opinion among seafaring men that no shelter is necessary; on this account construction of east breakwater has not been undertaken. While present indications point to necessity of construction of east breakwater for maintenance of channel against silting, expenditures in this direction not yet warranted.

During fiscal year 5,514 lineal feet of double-track and 48 lineal feet of single-track trestle completed, making total length of trestle on July 1, 1912, 10,927′. Fill dumped from trestle, 460,040 c. y.; in addition, 6,498 c. y. used for ballast and 4,680 c. y. furnished fortifications, all procured from Toro Pt. quarry, shut down June 22, 1912. Porto Bello rock for exterior of breakwater delivered Aug., 1911. Rock shipped in barges, transferred to Lidgerwood trains by locomotive cranes, and plowed off on the north side of the trestle; 65,133 c. y. unloaded in this way. Of rock removed by dredges from canal prism, 510,780 c. y. dumped in vicinity of trestle.

Filtration plant authorized for Agua Clara Reservoir Jan., 1911, completed Dec. 29, 1911. Due to shortage of water in Colon, Toro Pt., and Porto Bello, water transferred from Gatun water supply in barges, from Jan. 25 to May 23 to Toro Pt., from May 10 to June 24 to Cristobal, and from May 9 to 16 to Porto Bello.

During year usual maintenance done on roads, sewers, and drains. 10,000 sq. y. macadam laid and repaired, 15,000 lineal feet road ditches cleaned, 2,800 lineal feet curb and gutter laid, and 3,000′ of sewers installed. In addition, municipal improvements carried on in Colon.

Sanitary work consisted of cleaning and grading 336,000 linear feet ditches; constructing 8,000 linear feet of ditches, and lining with concrete 2,300 linear feet of ditches. **P-12**, 12-24.

1913. The work of excavating channel between Gatun Locks and deep water in Caribbean was in charge of Atlantic division until May 1, 1913, when it was transferred to sixth division of O. C. E. On this same date the dry dock and shops transferred to mechanical division.

At beginning of fiscal year dredges at work excavating area north of caisson sills of locks, within which flare or wing walls and north approach pier to be constructed. Wing walls built on rock and approach pier partly on rock, but for greater part on piling. For the former it was necessary to remove material to 70′ below sea level to uncover rock; as dredges could excavate only to 41′, level of the pool had to be lowered for them to perform the work. Clay dam built across cut excavated by dredges to reach this area, and water in resulting inclosure lowered by pumping with dredges. Excavation for flare walls carried well to rear and made sufficiently wide for walls and for rock fill to sustain the material back of it from sliding as water lowered. Fill also formed foundation on which to carry cableway tracks. Expected that by extending the rock fill to north cableway tracks could be laid, so that construction plant could build entire length of center approach wall; because of softness of material this plan had to be abandoned.

For approach pier dredges removed material to 55′ below sea level and for width of 140′ along center of excavated area. On completion of dredging, Nov., 1912, pit was filled with water, clay dam removed, dipper dredge and suction dredge taken out, and suction dredge, pump barge, and 2 coal barges left inside the area. Clay dam rebuilt and water pumped out, exposing foundations. Dredge grounded at 55′ below sea level and used to keep water below foundations. Two steam shovels worked over portion of center wall foundations where rock appeared, and excavated such material from approach to west locks as could be handled. Channel excavation and preparation of foundations accomplished by shovel, crane, cableways, and by hand.

Flare walls built solid. North approach wall or pier 58′ wide and consists of piers placed 50′ centers longitudinally and 40′ laterally, in which direction they are connected by arches of 22′ span, while longitudinally they are spanned by steel girders incased in concrete. In plan the piers are 10′ by 18′. Piers rest upon a slab of concrete, heavily reinforced with old rails near top and bottom, built on piling. First 6 of openings north of locks closed by curtain walls to prevent objectionable cross currents while locks emptying. Plan originally contemplated pier 1,200′ long, measured from angle of flare walls. Dec., 1912, division engineer recommended wall be shortened 200′. Slide occurred at north end of pit when it was dewatered, covering foundation of this portion of wall; removal of this slide, which would have to be done largely by hand, would be tedious and require considerable time; furthermore, this would make north approach wall correspond more nearly to one at south, which is 994.5′ long. Local conditions where south wall terminated such as to make cost of building additional length prohibitive; however, as considerable saving in time of completion would result, recommendation was approved and length of north approach pier fixed at 1,000′. Foundation for pier required 5,000 piles, aggregating 200,549 linear feet. For curtain walls 5,657′ sheet piling driven. On Jan. 25, 1913, while this work in progress, slide occurred on east side, which covered large part of foundation with 6 to 18′ of material, destroying 2 pile drivers and delaying work. Material was partly removed by crane and hand, but largely by sluicing and pumping, dredge handling material from sump.

Concrete in flare walls laid by cableways, which were also used for so much of the center pier as could be reached. Remaining portion of latter laid by cranes and dump cars operated by construction locomotives, concrete being supplied by cableways through hoppers and chutes. Total concrete laid in locks, 164,750 c. y.; 5,530 c. y. concrete used for construction of lampposts and bases, snubbing-button bases, machinery-room covers, control house, paving between upper lock and Panama R. R. station, under emergency dams, and for work of first division, making total handled by Atlantic division 170,280 c. y. Total concrete laid in locks by Atlantic division to close of fiscal year, 2,040,715 c. y.

Last fall estimated concrete of locks would be completed by July 1, 1913. By shortening north approach pier 200′, all concrete, except miscellaneous finishing, completed June 14, 1913. Miscellaneous work consists of lamppost bases, snubbing-button bases, mooring-post bases, stair-well parapets, paving, and the closing of a few openings left for construction purposes.

In addition to handling sand from barges to stock pile, unloading cableways were used for transferring sand and rock from stock piles to tunnel hoppers and for loading rock for sale to outside parties. Sufficient broken stone in storage; none crushed during year. 171,866 c. y. taken from storage pile for use by the division, 1,568.5 c. y. for issue to other divisions and sale to outside parties. To storage pile on hand at beginning of year 43,851 c. y. sand added, secured from Chagres River by suction dredge. Cement, in bags, amounting to 225,000 barrels, received and handled, partly by barges from ship and crane into cement shed, partly by car transfer, then by hand into shed. 227,000 barrels issued for use.

Back filling of side walls and filling of center wall made of material from borrow pits and from canal prism, aggregating 637,226 c. y., all removed by steam shovels. Of this, 565,756 c. y. placed behind side walls, and 15,872 c. y. in center wall by cableways. Total material used for back fill to June 30, 1913, 2,027,830 c. y. placed behind side walls, and 113,163 c. y. placed in center wall. Teams and scrapers put to work Mar., 1913, and continued to end of year, bringing back fill to final grade and for construction of wagon road along east side of locks. About 1,500 c. y. handled in this way. Decided to pave exposed surface of back fill between locks and Panama R. R. station with concrete slabs 5′ by 5′ by 6″, extending from elevation 78 to top of slope, and laid on from 4 to 6″ of broken stone from Ancon quarry. Below concrete paving slope to be covered with riprap down to elevation 74. On June 30, 1913, surfacing of broken stone completed and 125 sq. y. of concrete paving finished.

Lamp-posts and bases for illuminating locks constructed, bases erected, and lamp standards cast; of the latter, 211 were made.

Control house for Gatun Locks begun Apr., 1913.

At close of previous year Gatun Dam raised to 103.35′ for 1,000′ east of spillway, and for balance of this portion of dam dry fill had reached 96′ and hydraulic fill between them 85′. On portion of dam west of spillway north and south fills had reached 98′ and hydraulic fill 87′ at spillway and 78′ at drains in northwest corner of dam.

At close of current year sufficient material added to raise dam to full height, with 3 to 5′ additional along axis for settlement. Dry fill secured from borrow pit, beyond west end of dam, and clay used to top off hydraulic fill from borrow pits north of dam and in vicinity of locks. Two to six steam shovels engaged in procuring this material removed 2,159,159 c. y.; 922,877 c. y. were rock. Hydraulic fill supplied by 3 pipe-line suction dredges operated in borrow pits 1½ miles distant. Total handled, 493,145 c. y. Hydraulic fill stopped Sept., 1912. No complete survey made during year, but partial cross sections run monthly until Feb., 1913, from which material in place calculated, and for following months, estimates based on borrow-pit measurement. Estimated dry fill deposited aggregated 1,714,367 c. y. Total consolidated fill for year, 1,967.841 c. y. Levels run monthly to determine settlement, observations being taken on hubs placed about 250′ apart longitudinally and about 100′ apart transversely.

On Aug. 29 bulging and sliding movement began along north slope of dam near west end and continued. There could be no question that the movement was within the dam itself, consequently test pits not resorted to, as in the case of the movement on the east part of the dam a year ago. Line of wash borings with drive samples made. Borings indicated relative proportions of hydraulic fill and dry fill which would bring about the desired section of hydraulic fill—wedge shape, with the point down—not secured; on the contrary, hydraulic fill in section was opposite of this. Evident provision had not been made against slipping of dam material on itself. As in the case of the movement on north face of east portion of dam, toe was heavily reinforced and slope flattened to an average of about 1 on 7.67.

To prevent injury to dam from wash of south slope by waves in lake, necessary to pave portion of slope. Decided to use riprap laid on broken stone. Estimated waves 5′ in height might exist, so paving was extended over that portion of the slope lying between elevations 74 and 92. Layer of crushed stone laid over dam within these limits to thickness of 4″. Over this riprap was placed to protect broken stone from waves. Area of 115,740 sq. y. covered with crushed stone, of which 15,740 c. y. were used, completing this work in Apr. Riprap placed at close of fiscal year aggregated 68,739 c. y., covering area of 102,030 sq. y.

At beginning of year spillway dam had been completed, including abutments, ogee, and crest piers, to elevation 69, while central portion, 370′ in length measured along the crest, practically completed to elevation 50. Four sluices had been left—three closed by Stoney gates and one by a cylindrical valve—to permit control of water during construction of dam. During year the flanks carried to completion, while central portion, finished to elevation 50, was left at this height to allow flood waters to escape. Work on closing these openings commenced as soon as level of lake could be dropped below elevation 50 and work pushed. Trestle erected on flanks at elevation 95 and extended entirely around dam when full height of 69′ reached. From it the west abutment and part of crest piers built to elevation 115, or full height, and 14 crest gates installed. On completion of west abutment trestle beside each gate dismantled in succession and upstream side of pier, interfered with by trestle, constructed. In Feb. sluice operated by cylindrical valve closed, but it was impracticable to complete remaining crest piers and east abutment until the 3 remaining sluices could be closed. Lake, controlled by sluices, held at about elevation 32 until last week in Aug., when completion of guard gates and caisson sills of locks permitted it to be raised. During Nov. and early part of Dec. water reached maximum elevation of 56.3, notwithstanding flow through opening left in central part of dam and through sluices. After rainy season water lowered to elevation 48 so that work might be resumed on spillway, and sluices finally closed June 27, as plans contemplated raising lake to full height during "present" rainy season, starting with water at Gatun at elevation 50, July 1, 1913. Elevation of lake at Gatun on this date, 49.15. Advantage taken of flow over spillway to dispose of floating islands, snags, and old timbers. Anchorage basin to east of channel and channel itself for 6 miles south of Gatun cleared. Obstructions in channel 14′ thick. Such aggregations broken into small sections by floating pile driver.

Concrete laid in spillway for year, 21,719 c. y. Excavation, 175 c. y. Total concrete thus far placed in spillway, 224,132 c. y.

Architectural features added to plans prepared by first division of O. C. E. for hydroelectric power plant below spillway at estimated cost of $147,950; its construction undertaken by Atlantic division. Excavation completed, and during year 14,948 c. y. material removed—rock and earth; in preparation of foundations, 11,684 c. y. Total excavation to date, including preparation of foundations, 98,751 c. y. Steel work for structure advertised; lowest bid amounted to $25,456.37. Successful bidder offered to erect steel structure in 45 days at additional cost of $6,496.74. Atlantic division estimated $4,643. This work assigned to Atlantic division. Erection of steel work commenced May 16; at close of year about 65 per cent had been erected and 90 per cent of the field rivets driven. Penstocks incased with concrete, except for curved portions near head gates. Forebay walls with trash-rack and stop-plank grooves about 95 per cent completed.

West breakwater, Limon Bay, continued. 599′ of trestle, single-track, added, making total length of trestle 11,526′. Total rock received from Porto Bello and placed on breakwater, 183,762 c. y., of which 102,508 c. y. handled from barges to Lidgerwood cars by locomotive cranes and subsequently plowed off. Balance placed by derrick barges. In addition, 220,433 c. y. rock removed from channel by dredges and dumped on breakwater. Small pile wharf built for handling rock by cranes to cars, and 3,000 c. y. sand dredged by derrick barge for barge berth.

Quarry at Porto Bello worked during year for supplying large rock required for breakwater. Because of peculiar formation of hill it was found sufficient large rock could not be secured from the 2 benches to complete breakwater; development temporarily suspended. In Nov., 1912, operations resumed by steam shovel in old crushed-rock quarry, above the 2 benches; after the first of the year 2 more shovels put to work on this higher level. Broad-gauge equipment, substituted for narrow gauge previously in service, placed in operation on Oct. 5, 1912, and output increased from 2 to 3 barges per day. In securing rock of proper size about 60 per cent of output wasted.

Waves from trade winds have been washing shores of Limon Bay in vicinity of canal entrance; survey made Mar., 1913, showed that channel in vicinity of shore line, dredged to full depth, had filled as to give available depth of only 27′ and that in center of channel. Estimated that silt deposited in channel during previous 12 months was 2,213,032 c. y. On investigation, believed this silting is due to wave action disturbing soft material of bottom of bay. Atlantic Fleet during its visit anchored under lee of west breakwater; at times trade winds made it difficult for small boats to reach ships. General Board of the Navy advocated detached breakwater for protection of anchorage area. Construction of detached breakwater on east side contemplated. Investigations undertaken to find quarry more accessible than Porto Bello. To still further protect channel against material washed from shores of bay experimental stone dikes to be constructed.

As previously reported, water supply for Colon not adequate; plans submitted for modern filtration plant and pumping station. Project approved on July 12, 1912, at cost of $193,768. It contemplates tunnel through divide separating Gatun Lake from Brazos Brook Reservoir, within which is to be laid a 20″ main, with its inlet at an elevation of approximately 5′ below extreme low-water level in Gatun Lake. This pipe line, 600′ in length, extends to Brazos Brook Reservoir, and by means of control house water in reservoir is maintained at minimum low level of 1′ below spillway crest, so that additional amount of water required over that furnished by the watershed will be taken from Gatun Lake. Additional 20″ main laid from Brazos Brook Reservoir to Mount Hope. In connection with these there are included aeration basin, sedimentation basin, and filters after passing which water enters clear-water basin having capacity of 650,000 gallons. Basin connected by underground conduit to pump sump beneath floor of pumping station. Pumps will be operated electrically. Work commenced Oct., 1912, and at close of the year all work between Gatun Lake and Brazos Brook Reservoir practically complete. Pumping station completed ready for installation of machinery; filter building completed to and including operating floor; sedimentation basin 75 per cent completed; and foundations and floors of mixing chambers and aeration basin laid. In addition to operation of purification plant at Agua Clara Reservoir, usual maintenance work carried on.

Approximately 70,000 sq. y. macadam laid and repaired, 44,000 linear feet road ditches cleaned and dug, 9,500 linear feet of curb and gutter laid, and 4,600′ of sewers installed. In addition, municipal improvements carried on in Colon. Of appropriation of $800,000 made by act of Mar. 4, 1909, for extending municipal improvements in Colon and Panama, there were expended during year in the former locality $53,939.15, making total in Colon to end of year $505,909.54. In addition to completing improvements previously undertaken, money expended in replacing curbs and gut-

ters which had settled, resurfacing, and in extending improvements to include G Street between Second and Ninth Streets, and in extension of E Street to its intersection with the Mount Hope Road.

Sanitary work consisted of cleaning and grading 237,000 linear feet of ditches; constructing 53,000 linear feet of ditches, and lining with concrete 26,000 linear feet of ditches. In addition, 6,800 linear feet of pipe and tile drains were laid and cleaned. **P-13,** 13-22.

1914. Effective Oct. 15, 1913, concrete work remaining to complete the construction of the locks at Gatun transferred from the Atlantic division to first division, which could do it in connection with installation of the machinery and towing tracks with the same supervisory force; similar unfinished work in connection with the Pacific Locks was also transferred to the first division at the same time. **P-14,** 2.

Remaining work in Atlantic and fifth divisions having reached such a stage as not to justify the administrative charges that the existing organizations called for, these two divisions were abolished Feb. 1. Their property accountability transferred to quartermaster's department and their records turned over to fourth division, O. C. E. **P-14,** 2.

Construction of west breakwater and operation of Porto Bello quarry transferred to second division, O. C. E., while work remaining at Gatun Dam, El Cano saddle, back fill at Miraflores, Miraflores spillway channel, Ancon quarry, and the sluicing at Gold Hill were placed directly under the chief engineer. **P-14,** 3.

Atmosphere. (See Meteorology.)

Attorneys. (See Nos. 252, 273, p. 2368 of this Index.)
  Chief attorney. (See Orders, Executive.)
  Prosecuting attorney, duties defined by zone laws. Acts as legal adviser to the governor; prosecutes offenses against laws of the zone; investigates and settles claims against the Isthmian Canal Commission. Work expected to assume large proportions as work of construction increases. **P-05,** 68.
  Special attorney's office, **P-14,** 409, 511.

Auditing. (See Nos. 75 and 149, pp. 2363, 2364 of this Index.) (See Accounts.)
  Canal costs to be audited by Auditor for War Department, **P-11,** 558.
  Final audit of all expenditures should rest with Isthmian Canal Commission, **P-50,** 121.
  Organization, **P-05,** 107, 179.
  Organization for canal, zone, and Panama R. R., **P-05,** 21.

Auditor. (See Nos. 123 and 269, pp. 2364, 2368 of this Index.)

Audits and Disbursements.
  Under laws of zone, auditor and disbursing officer of the Isthmian Canal Commission made, respectively, auditor and treasurer of the zone, **P-05,** 72.

Auditor for the War Department.
  Canal costs to be audited by, **P-11,** 558.
  Final audit of Isthmian Canal Commission accounts vested in, **P-05,** 21.

Automatic Railroad Signals. (See Signals.)

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Bachelor Quarters. (See Quarters.)

Backfill. (See Fill.)

Bacteriology.
  Examinations of reservoirs, **P-07,** 78.
  Water supply, **P-08,** 111, 115.
  Panama and Colon water supply, **P-08,** 118.

Bail and Bonds.
  Executive order, **P-14,** 561.

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Ballast. (See Panama R. R.)

Banks. (See Slides.)
  Breaks, Chagres R., **P-10,** 160, pl. 28.
  Breaks in, Culebra, **P-10,** 160, pl. 39; **P-12,** 170, pl. 41; **P-13,** 160, pl. 41.
  Cut in, Empire; letting Obispo diversion through, **P-10,** 160, pl. 24.
  Slides in, Culebra, **P-11,** 156, pl. 34.

Barbers. (See Clubhouses.)

Barges.
  Concrete, of, **P-10,** 196, pl. 49, 50, 115.
  Performance of, Pacific division, **P-11,** 163.

Barges, Derrick.
  Placing rock, Toro Point breakwater, **P-13,** 138, pl. 30.

Barges, Drill.
  Operation, **P-10,** 174; **P-11,** 169; **P-12,** 184.
  "Teredo," operation, **P-10,** 175; **P-11,** 169; **P-12,** 184.
  Performances, **P-10,** 175.

Barges, Hopper.
  Clapets, or self-propelling, French type, **P-07,** pl. 39, 40.

Barracks. (See Labor; Marines.)

Barrier.
  Blowing up between Pacific and Miraflores, **P-13,** 186, pl 53.

Basalt Dike. (See Dike, basalt.)

Bascules. (See Bridges.)

Base. (See Surveys.)

Basins, Anchorage.
  Clearing, Gatun, **P-09,** 80.
  Culebra Cut, view, **P-12,** 170, pl. 28.

Basin, Clearwater.
  Gatun waterworks, **P-11,** 132, pl. 24.

Basin, Drainage. (See Discharge.)

Basin, Entrance. (See Terminals.)

Basin, Sedimentation. (See Sedimentation.)

Bates Project. (See No. 170, p. 2365 of this Index.)

Beacons. (See Channels.)
  Channels, **P-11,** pl. 93; **P-14,** pl. 62.
  Plan, general, **P-12,** pl. 77.
  Typical b., **P-13,** 110, pl. 17, 18.

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  Reinforcement, Balboa terminals, **P-14,** pl. 28.

Benchmarks. (See Surveys.)
  Precise leveling, **P-08,** 127; **P-09,** 127; **P-10,** 297; **P-11,** 280; **P-12,** 247; **P-13,** 244; **P-14,** 207.

Bertoncini, C. (See No. 204, p. 2365 of this Index.)

Bertrand. (See No. 194, p. 2364 of this Index.)
  Geology, Culebra and Emperador, **P-06*,** 162.

Bids. (See No. 148, p. 2364 of this Index.)
  Preference to be given U. S. bidders, **P-11,** 560.
  Proposal forms, etc., **P-05,** 171.

Billiards. (See Recreation.)

Bills. (See Account.)
  Tables of bills included in reports of examiner of accounts.

Bills of Health. (See Health.)

Bins, Storage.
  Balbao, **P-10,** pl. 116.
  Layout of plant, Ancon quarry, **P-09,** 134, pl. 58.

Birds.
  Executive order protecting certain, **P-13,** 616.

Blackburn, Jo. C. S. (See Nos. 217, 225, p. 2366 of this Index.)

Blacksmithing. (See Shops.)

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  Blanketing ridge of Gatun Dam, **P-11,** 132, pl. 20.

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  Bas Obispo, **P-07,** 48, pl. 19, 20, 21.
  Before and after blast, San Pablo, **P-08,** 56, pl. 15, 16.
  Central division, **P-09,** 70; **P-10,** 140; **P-11,** 136; **P-12,** 146; **P-13,** 142.
  Chagres division, **P-08,** 45.
  Cucaracha slide, **P-14,** pl. 52.
  Culebra division, **P-07,** 41; **P-08,** 37.
  Drilling, rate of, **P-07,** 41.
  Excavating before and after blasting, **P-08,** 56, pl. 15, 16.
  Obispo, **P-07,** 48, pl. 19, 20, 21.
  Slides, effect on, **P-12,** 214.

Board of Admeasurement, P-14, 262.

Board of Consulting Engineers. (See No. 164, p. 2365 of this Index.) (See Construction; Canal, Lock; Projects.)

  Executive order forming Board of Consulting Engineers. Dated June 24, 1905, at the White House. Issued by President Roosevelt. Names members of board. To convene at Washington, Sept. 1, 1905, "for the purpose of considering the various plans proposed to and by the Isthmian Canal Commission for the construction of a canal across the Isthmus of Panama between Cristobal and La Boca." **P-06*,** 9.
  Members: George W. Davis, major general, U. S. Army, retired, chairman; Alfred Noble, chief engineer, East River division P., N. Y. & L. I. R. R.; Wm. Barclay Parsons, chief engineer, New York Subway; William H. Burr, consulting engineer, Board of Water Supply, New York City; professor of civil engineering, Columbia University, engineering expert, Aqueduct Commissioners, New York City; Henry L. Abbot, brigadier general, U. S. Army, retired; Frederic P. Stearns, chief engineer, Metropolitan Water and Sewerage Board, Boston; Joseph Ripley, general superintendent, St. Marys Falls Canal; Isham Randolph, chief engineer, Sanitary District of Chicago; William Henry Hunter, member Institute of Civil Engineering, chief engineer Manchester Ship Canal, commissioner, upper Mersey navigation, England; Eugen Tincauzer, Königlich Preussischer Regierungs- und Baurat, Mitglied der Regierung zu Königsberg i. Pr., Germany; Adolphe Guérard, Inspecteur-Général des Ponts et Chaussées, France; E. Quellennec, Ingénieur en Chef des Ponts et Chaussées; Ingénieur Conseil de la Cie. du Canal de Suez, France; J. W. Welcker, Hoofdingenieur-Directeur van den Ryks-Waterstaat, The Netherlands. **P-06*,** 3.
  Mr. Schussler declined appointment, as did Mr. J. B. Berry, chief engineer of the Union Pacific R. R., named in Mr. Schussler's place. Prof. Jacon Kraus, representative of

Holland, declined, J. W. Welcker being named in his place. At the first meeting, announced that Capt. John C. Oakes, Corps of Engineers, U. S. Army, had been detailed as secretary of the board. **P-06***, 9.

Instructions: Board of Consulting Engineers was addressed Sept. 11, 1905, by President Roosevelt. "But if to adopt the plan of a sea-level canal means to incur great hazard and to insure indefinite delay, then it is not preferable. * * * Two of the prime considerations to be kept steadily in mind are (1) the utmost practicable speed of construction; (2) practical certainty that the plan proposed will be feasible—that it can be carried out with the minimum risk. * * * The delay in transit of the vessels owing to additional locks would be of small consequence when compared with shortening the time for the construction of the canal or diminishing the risks in the construction." **P-06***, 12.

Organization of committees: Executive, chairman, Gen. Abbot, and Mr. Hunter. On preparation of plans for sea-level project, chairman, Messrs. Guerard, Hunter, and Burr, to which Messrs. Parsons and Quellennec were added later. On preparation of plans for lock canal, chairman, Messrs. Stearns, Tincauzer, and Ripley, to which Gen. Abbot and Mr. Noble were added later. On unit prices, Messrs. Parsons, Welcker, and Randolph. **P-06***, 11.

Minutes, first to thirtieth meeting: First one, Washington, D. C., Sept. 1, 1905; thirtieth, New York, N. Y., Jan. 31, 1906. **P-06***, 105–148.

Summary of proceedings, **P-06***, 9.

Report, 1906. Pages 1–426. (See Projects and No. 164, p. 2365 of this Index.)

Letters of transmittal: President Roosevelt, Feb. 19, 1906. Sec. of War Taft, Feb. 19, 1906, to the President. Chairman Shonts (T. P.), Feb. 6, 1906, to Sec. of War. **P-06***, III to IX.

Physical data concerning canal projects: In letter of Sept. 1, 1905, the chairman of the Isthmian Canal Commission No. 3 laid before the Board of Consulting Engineers physical data concerning the Isthmus of Panama, and solicited opinion of the Board of Consulting Engineers as to the best plan to be followed in the completion of the Panama Canal, **P-06***, 10.

Plans laid before Board of Consulting Engineers: Plan of Isthmian Canal Commission No. 1; plan proposed to the New Panama Canal Co. by the Comite Technique assembled by that company; 3 projects prepared by Lindon W. Bates, of New York; the more important results of recent surveys, containing the principal information available for a decision respecting a canal at tide level; paper prepared by Mr. P. Bunau-Varilla, explaining method of construction of a lock canal to be later transformed to one at sea level; paper on the Panama Canal showing some serious objections to the sea-level plan by Maj. C. E. Gillette, Corps of Engineers, U. S. Army, and paper by C. D. Ward, civil engineer, on the Gatun Dam. The Board of Consulting Engineers received no plans originating with Isthmian Canal Commission No. 3. **P-06***, 11.

Plans considered: List of data, etc., furnished by the Isthmian Canal Commission No. 3, **P-06***, 106.

Work done and "present" conditions on the Panama route: Review of the history of work done and that going on at Panama, **P-06***, 22.

Field work: Examinations requested by the Board of Consulting Engineers to gain additional information relating particularly to possible dam and lock sites at Mindi, Gatun, and in the vicinity of La Boca, **P-06***, 25.

Inspection of the Isthmus: Record of work of inspection in detail performed by the Board of Consulting Engineers at Isthmus of Panama, Oct. 4–11, 1905, **P-06***, 124.

Vital statistics: Appendix O. Compiled under direction of Col. W. C. Gorgas, chief sanitary officer, **P-06***, 407–409.

Unit prices: Report of committee on unit prices. Appendix R, **P-06***, 419–420.

Hearings of J. F. Stevens, chief engineer: Appendix J., Board of Consulting Engineers. Most advantageous type of excavating machine the steam shovel. State of chaos on the Isthmus on assuming charge. Had not had time, at time of examination by Board of Consulting Engineers, to study any of the engineering problems of the canal. Dumps in use small. No detailed plan for dumps had been worked out; Culebra excavation an unknown quantity; ordinarily 1,000 yards a day per shovel output in excavating; Culebra Cut not in good shape for working in; could get 50 shovels or so installed in about 10 months. "I have never believed * * * that under the greatest stress we would require on the Isthmus the presence of over 100 excavating machines. * * * I am talking about the Culebra Cut." Eight-hour law a handicap. "The question of handling the Culebra Cut is very largely one of transportation; and by transportation I do not mean simply hauling it; I mean disposing of it—getting rid of it. It is going to require the most perfect organization that ever was contemplated." "The French company fell down because they could not dispose of their material. * * * They loaded more than they could get rid of. * * * They used a type of car that would not dispose of the material; it had to be cleared by shoveling. * * * This is no reflection on the French, but I can not conceive how they did the work they did with the plant they had." Discussion of the slopes to be adopted for Culebra Cut. Has made no computations of quantities in the Culebra Cut. Labor will work only about 19 days per month. 13,000 men, white and black, on the work. * * * "Force of men (employed) I have who go around and put the laborers out of their houses unless they work (large number required for this)." Can not determine the size of the force to employ until the U. S. determines what kind of a canal is wanted. Comparative value of American labor and foreign not to latter's credit. Discussion of unit of cost of excavation. Great deal of the cost of work done due to derailments, and sometimes the gangs were not kept full. Would not recommend that the Board of Consulting Engineers take less than 80 cents as an average of cost per yard for the Culebra Cut. Value of French plant—most of it of little use; some of the rails can be used with bridle rods; dredges of doubtful value. "We have never been able to get over 2,700 or 3,000 yards a day of 10 hours per dredge." Thinks suction dredge the best dredge in the world. Would cut channel with dipper dredge, following it with hydraulic machines. Use of materials excavated—some for concrete material, rock for construction, gravel for concrete. Methods of unloading cars quickly; judicious to keep trackage in good shape; would have several tracks to a dump. Thinks he could find a better method than that proposed by Bunau-Varilla for reducing to sea level. Does not know the nature of the strata in the lower part of the Culebra Cut; could not tell what would be necessary for retaining walls. Using excavated material for earth dams a matter of cost; discussion of methods of handling excavated material for dams; special trackage would be necessary; some material might be pumped. Had no opinion as to safety of earth dams of large sizes on the Isthmus; thinks safety of any dam dependent upon the capacity of the spillway; would prefer earth dam with a masonry core to one without this core; dredged material makes very compact work. Had no opinion as to merits of sea-level or lock canal. "I think either one would carry a ship through all right." Cost of double-track railroad probably $75,000 to $100,000 per mile in gold. Culebra slides might be conquered by tunneling under the masses to drain it of water. "Anyhow, I think we need not worry about whether the Panama Canal can be built owing to that slide." Some draining done by French. "Give us the type of canal just as soon as you can. * * * I can not, and I do not believe any human being can, do much more than mark time until that is done. I can fix my quarters, and as far as my limited intelligence permits me I can contract for certain rolling stock. I have contracted for two or three million dollars' worth of plant the last month, but beyond that I can not go. Here is this little railroad; we have got to have better terminals at the south end. I want a better yard at La Boca, but you may select an alignment which will interfere with any improvement I might start now." Discussion of the sources from which materials can be had for concrete, breakwaters, etc.; crushing rock for sand; advantageous mixtures for concrete. **P-06***, 283-295.

Hearing of F. B. Maltby, division engineer at Colon, has charge of works there and also those of the Pacific terminus of the canal. Appendix J., to Board of Consulting Engineer's report. **P-06***, 296-306.

About 600,000 c. y. dredged in harbors in 6 months of 1905. Only 16′ available at La Boca Harbor. Constant fill. Dredging in progress to get 22′ below spring low tide. References to unusual high tides at terminals. Silting in harbors at rate of about 1′ a month; probably due to drift; very little from Rio Grande River. Capacity of French dredges—139,000 c. y. removed in month at La Boca with a double crew. "That represents her maximum capacity." Prefers hydraulic dredges to those of French or ladder type. Discussion of the cost of pumping dredgings ashore; could be put ashore for 6 or 7 cents; do not believe it would exceed 10 cents; use of cutters advantageous; nature of material determining methods and cost. Probable sources of material for breakwater building; location of rock, its nature; identity of soft rock in dry dock at Cristobal and that from borings on site of Gatun Breakwater and pier construction at terminals; foundations. Maintaining channel entrances; necessity of constant dredging. Constant dredging required at the Suez Canal entrances; at North Sea Canal entrances. Annual dredging at La Boca would require probably 1,000,000 c. y. annually. Breakwater at Guinea Pt. would not be worth its cost. Silting of terminal harbors due to sea currents; does not believe important amount comes from Rio Grande. Dredgings, rehandling cost lower than original dredging; to put dredgings into a dam, say 40 or 50′ high, would cost not to exceed 20 cents per yard. Would not recommend suction dredges to load scows; would put in 2 dipper dredges for 1 suction dredge. Tides at La Boca and at Cristobal; tabular matter. **P-06***, 296-306.

Hearings of H. F. Dose: By Board of Consulting Engineers. Appendix J. Since July 1, 1904, 700,000 c. y. removed at Culebra, or 800,000 c. y. since Americans assumed control Cost arbitraries. Different outputs in different month large variations; difference due to rainy season and change in rate of pay for labor, and trains off the track and soft character of material. Yardage computed from the cross sections and checked by car report. Figures for computed excavation and total yardage in the Culebra whence obtained; explanation of discrepancies based on different prisms being employed in computing. Unit cost for material taken out; probably would be 70 cents per c. y. in Culebra. Starting of steam shovels: No. 101 (probably the first) started Nov. 11, 1905. Types of shovels: Five-yard dipper good in heavy work; 2-yard dipper efficient in soft material and on hillside. Loading and dumping costs; what is included under dumping costs and under transportation. In lower excavating, pumps may have to be used, or else some of the smaller streams may have to be let into the cut or diverted. Eight-hour law a source of increase in cost of excavating. Rock at various points on the canal line. P-06*, 307-314.

Hearing of Charles Bertoncini: By Board of Consulting Engineers. Appendix J. Draftsman in employment of old French company, the new Panama company, and by the U. S. since work was taken over. Profile of the geological section of the canal; section 40 to 50′ long; shows character of material as developed by borings before the year 1883 for a sea-level canal. Various maps and plans, sketches, etc. Cross sections made by the last French company when the work stopped; they made a project for the canal with 2, 4, or 6 locks; sections and profile show amount of material to be excavated; calculating methods of quantities. Book of cross sections of the canal line mentioned; set in existence of profiles from kilometer 0 to kilometer 74 (50 for each kilometer). Panama Bay and Harbor map showing currents. Dike at Rio Grande; proposed dam to make a harbor at La Boca; tidal lock. Control of small rivers like Obispo and Lirio; various methods, aqueducts, syphons, etc. Dredging Culebra from pool; same scheme at Cascadas and others. P-06*, 315-320.

Hearing of W. E. Dauchy, assistant to the chief engineer of the Panama Canal: By Board of Consulting Engineers. Appendix J. When he took charge at Culebra, Nov., 1904, there were 1 modern American steam shovel and 2 or 3 French excavating machines at work, and about 700 laborers. Instructions were to prepare for installation of steam shovels ordered; intention to carry along the preparatory work in the way of track laying, establishment of dumps, and installation of machines, "keeping the work done along the different branches advanced as rapidly as the needs of the installation of the new shovels should require. At that time the tracks consisted only of the old French tracks, and they were in very bad condition, and there was a large amount of work required to put those tracks in workable shape as well as to lay new tracks for the use of the trains waiting upon the additional shovels to be installed." In following Aug., 11 steam shovels working; French machines had been discarded; on Aug. 10 majority of steam shovels put out of service on account of the pressing necessity of doing preparatory work, and not having sufficient labor to carry on the work of preparation and the work of operating the steam shovels at the same time. Shovels the only modern implements; locomotives antiquated, cars antiquated, track not up to requirements; dumping grounds not established, trains congested; did not approximate the capacity of the shovels; weather cut but a small figure on the shovels, affected track, etc. Shovels of 2½-yard capacity should handle 2,000 to 2,500 yards a day of 10 hours, 50 per cent of that the net capacity. Considered an efficient condition of trackage, etc., attainable at Culebra. For removing about 100,000,000 c. y. from Culebra, for sea level, thinks 80 to 100 shovels adequate for economical operation; 2½-yard and 5-yard types. To install this equipment would take about 2 years with the same class of labor as used in 1905-6. Expected that on an average 6 per cent of equipment would be laid up for repairs. No great difficulty expected from night work, nor advantage; not hurtful to health. Labor on Isthmus inefficient—4 men to do an American laborer's work; independent, as they realize shortness of labor supply; about 25,000 men needed for a 100-shovel equipment; in addition, force would be required for preparatory work of track laying, etc. Drainage of surface water; no general plan would cover all instances; some small streams would have to be carried in prism, etc. Effect of 8-hour law to increase cost of output about 30 per cent. Has thought of two methods of solving the labor problem—flooding the Isthmus with labor, forcing competition and dependence, and importation of foreign labor, like Chinese and Japanese. Night work would practically double the call for laborers, etc., and a consequent caring for them in quarters. Shovels, efficiency, net about 1,000 under favorable working conditions, or 300,000 c. y. per year per shovel. Dumping arrangements: Panama R. R. as main track, spurs to it from excavating point, and spurs from it to dumping points; dumps long distance from Culebra, some on the Atlantic coast section; Gamboa Dam site not economical site for dumping; French dumps worked on wrong principle; about 200 to 300 miles of track required for 100-shovel plant; 15 to 20′ face dumps best; not economical to dump from trestles. Moving plant of the French valueless almost wholly to Americans; ideal method or plant flat cars permitting unloading with scrapers, etc.; in wet weather material has to be shoveled out of existing cars. Character of material: Great bulk of material called rock is soft rock (indurated clay); unit price for removing earth at a figure equal to that for soft rock; soft rock will permit slopes of 1 on 1; not safe to channel sides practically vertical; in some places they have stood for years, "in other places they would not stand for months." Sides, slopes, etc.: No slides of any extent noticed in the rock section; disintegration of soft rock would be less swift if the slope were very steep; wash from drainage a cause of disintegration; as work progresses proper slope should be found. Thinks Culebra Hill itself, apparently massive rock, would be safely sloped 1 on ½; existing steep slopes at Culebra might not stand with deeper excavation. Material of the Culebra Hill section: More or less rock; good deal of clay, too; vegetation, except grass, increases tendency of slopes to slide. Would estimate 50 cents c. y. as proper price were contractor to do the work of the Culebra Cut; if 8-hour law were in operation against contractor, price should be increased probably 25 per cent. If Gamboa Dam were to be built, material of Culebra Cut might make it advisable to bring material from Culebra; otherwise, it would be cheaper to find some other dump for Culebra matter; extra cost might be 15 to 20 cents a c. y. Trackage for dumping: Special tracks necessary for dumping at Gamboa; 1 track for high elevations, and 1 for lower ones; a track to the Gamboa site would be notably expensive; Panama R. R. would have to be double-tracked for satisfactory dumping output; small stretch on summit, about 5 or 6 miles, would not need to be double-tracked. Labor required at Culebra: Probably as estimated by chief engineer, i. e., 30,000; hard to figure on number needed; "at present" the most expensive labor in the world, equal to paying $6 a day in the U. S.; similar labor in Nicaragua cheaper because supply was abundant. Favorably inclined toward U. S. feeding its labor. Wages of employees from U. S. about 40 per cent higher for same work in U. S.; doubtful if this has attracted efficient men; difference probably 50 per cent when transportation, etc., is included. Slides: Seemingly insignificant compared to the whole body to be removed. Effect of water on sides of rock nearly vertical; would probably not affect rock at depths; advisable to have a berm, however; slope of 1 on 1 without berm might result in slides from toe washing out; should not advocate putting vertical face in soft rock at final or bottom elevation of canal channel; perhaps retaining walls would be needed. "My opinion is that most of that material would be of such a character that it would stand on a slope of 1 on 1, but I doubt whether the majority of it would be of such a character as to stand vertically." (Panama Canal Co. (new) built test pits, filled them with water with depths of not less than 30 or 40′; after a number of years they were pumped out; water had had no disintegrating effect on material of sides.) If sides were 8 to 1 and 200′ high, slides would bring large mass into prism; disintegration, lesser quantities. Sand for masonry: Panama beach sand most available; Chagres River sand mixed with other materials; some sand near mouth of Farfan River; sand deliverable along canal line for about 75 cents a c. y. Steam-shovel operation, 1904–05: 24,000 men needed for 100 shovels, of which 20,000 common laborers; lowest expense in Mar., 1905; highest in Aug., 1905; explanation of maximum and minimum cost; supply of laborers did not increase in the proportion required for efficiency; expensive men increased; preparatory work was not finished; rainy season came on; numerous derailments, etc.: dumps were getting higher; French plant not adapted for rapid handling under such conditions; work was practically stopped at Aug., but the expensive organization still remained, increasing unit cost of what work was done; 8-hour law had an effect, also, corresponding to about 25 per cent increase; after the rainy season 12 to 20 derailments a day; derailments due to poor track; wheel gauges of the wheels of the French cars varied in almost every car; shovels working only about 2 or 3 hours a day; trains had to be unloaded by hand. Dumps varying in height from 12 to 20′ recommended, with the use of flat cars with Lidgerwood unloaders. One cause of derailment the imported rails being too high in proportion to width of base. Considers it feasible from his experience on the Isthmus to provide such plans and tracks as would practically obviate the difficulties already recorded. Yardage cost increased through work of shaping up the banks, etc.; percentage of cost greater with smaller equipment of shovels. Stone for jetties: Possibility of opening quarry at Bohio. At time of testifying 11 steam shovels set up and 6 others under erection; total on hand or ordered, 60; 120 locomotives ordered. Table showing estimated force needed to prepare for and operate 29 steam shovels, 50 steam shovels, 81 steam shovels, and 100 steam shovels; also existing force, balance needed, and portion of proposed force needed as each additional steam shovel is received between June 1 and Dec. 31, 1905; Dec., 1906 (2 estimates); and Dec., 1907, respectively. **P-06***, 321–345.

Estimates: Notes by Mr. John F. Wallace on the report of the chief engineer, Isthmian Canal Commission. Bohio Locks spillway; excavation Bohio to Miraflores; item relating to Chagres and Gatun diversion; estimates referred to by the "notes" probably in an emergency report called for on short notice. **P-06***, 370–371.

Hearing of Mr. John F. Wallace, formerly chief engineer, Isthmian Canal Commission. Appendix F. Board of Consulting Engineers. **P-06***, 346–393.

On Oct. 27, 1905: Board of Consulting Engineers would like to have the benefit of his experience and his advice as to what he considers to be the maximum quantity that could be removed from the central cut from Obispo to Paraiso in the course of 12 months after the proper appliances are installed; and what length of time "he contemplates" would be required for the installation of a plant. Mr. Wallace sought a week in which to properly present what information he could give. Those under him saw but one detail; not the general plan as formulated by the head himself. **P-06***, 346–349.

Statement of Mr. John F. Wallace, formerly chief engineer, Isthmian Canal Commission. Appendix F. Board of Consulting Engineers. **P-06***, 375-393.

Explanation of diagram (p. 367) for showing carrying on of work of excavation by steam shovels and trains; the more terraces, the steam shovels can work. Papers submitted more apply principally to the 5 or 8 miles of central excavation; when Board of Consulting Engineers was there (Culebra) they saw only a mass of tracks, etc.; this the old French installation; when Mr. Wallace took charge he retained this installation and worked it to ascertain its value; 1 excavator of French type did work at less than 5 cents a yard. Method of determining rate of increase in shovel equipment annually; could get as many shovels as wanted, but based his estimates for plan of practical operation on a minimum; installation of 24 shovels a year additional refers principally to Culebra section. Had not formed any estimate of what the additional cost per yard would be for pumping in a sea-level project. Discussion of the difficulties of cofferdamming in deep and narrow cuts which might be made preliminary to digging a sea-level line. Rock-removal methods mentioned Lobnitz system familiar to a member of the board (Mr. Hunter). Agrees with board that it might be more prudent to regard that the whole of the Culebra may be removed in the dry, down to about 10′ above sea level; impossible to say what it would cost to pump out lower levels. Committee on unit prices adopted figure of 45 cents per c. y.; considered a matter of some uncertainty; "no man knows how much it will cost." Drainage to prevent slides; discussions; method probably efficacious; slides as a question should become of less importance with each year of work if material be properly handled in dry season. Condition of bottom at 2 terminal harbors not the same; not so much mud at Panama Bay. Coal: Price lowered from $7.50 to $5.50; correction of testimony of Mr. Dose, who announced it as $7.50. Chagres River treatment would be simplified by construction of Gamboa Dam, leaving only regulated flow to care for; the latter being cared for by the prebuilt diversion channels; no precise calculations made as to capacity of these diversion channels. Excavated material of Culebra section to go, most of it toward the Pacific end; excavation material between Bohio and Gamboa could be disposed of over the side, at probably 35 cents per c. y. Material from Culebra Cut could be used for partial earth dams, with a core wall; material in Chagres River could be made available for concrete. Favors a composite dam for Gamboa. Concrete making: Might make 8,000 to 10,000 c. y. a day for Gamboa Dam, depending upon the supply of cement, stone, etc.; local rock could be used. Dumps provided for in general way; records of this evidently not found by Mr. Stevens (his successor); average haul from Culebra, 10 to 12 miles, with 100,000,000 c. y.; explains general method of handling—flat cars, use of unloaders, power bank spreaders, dumps 15′ high, long tracks and many of them, troubles have come from dumps which have been too high, economy in having cars waiting to be loaded, and in wide and high terraces. Concrete work of locks: Thinks 10,000 c. y. concrete could be placed per day in lock building; labor on this work might be 25 to 30 per cent less efficient than in U. S. Local labor about one-half or one-fourth as efficient as similar in U. S.; inefficiency due somewhat to inefficient overseers; 1 batch of 25 foremen sent from U. S. to Isthmus to superintend track work had never laid a rail in their lives. Possible to use dredges on the Atlantic side as far as Bohio. Prefers coal at $4 a ton to fuel oil; advocates an early building of Gamboa Dam to acquire electric power for work on the canal. Minimum of 21 working days on the Isthmus; would expect to work more; would expect to load more than 800 yards a day. Does not think there is any difficulty about providing materials from the Isthmus for the lock at Ancon-Sosa. Dredging constantly would be necessary to keep open deep ship channels at the Panama entrances. Vote of thanks given to Mr. Wallace for his papers and the information orally. **P-06***, 375-393.

Notes on the Panama Canal, by John F. Wallace, formerly chief engineer, Isthmian Canal Commission. Appendix F. Board of Consulting Engineers. **P-06***, 350-371.

The Chagres Valley, Gamboa Dam site, and river control; borings and alignment; technical studies; Culebra excavating work and cost records; sea-level sections of canal; cost of Culebra work from July 1, 1904, to Oct. 1, 1905; mining; excavations; maintenance of tracks; transportation; dumps; general expenses; arbitraries. Various suggested plans: The Bates plan saves only a small amount of work and substitutes a large amount of dam and dike construction, etc.; plan of first Walker commission objectionable; impracticable to provide a sea-level canal in the future, and Bohio Dam would have to be constructed at a point not wholly desirable; the various high level, multilock plans objectionable, as they render sea-level construction impracticable financially; plan of Bunau-Varilla for deepening and enlarging the canal "entitled to consideration and is ingeniously devised." Wallace has been controlled in his studies of the subject by: (1) No high dam should be constructed that could not be founded on bedrock or to which an impervious curtain wall could not be carried; (2) the construction of any high dam should be avoided, the destruction of which would prevent the operation of the canal until the dam had been replaced; and (3) if it became absolutely necessary to construct dams on

alluvial foundations, the plan should be selected necessitating the smallest amount of construction of this character, and subject to the least possible head of water retained thereby. Time required for sanitation, organization, and preparation would remain practically the same with any plan that might be adopted; output would increase steadily each year; experience would give increased efficiency to the force. The plans which have been suggested by reputable engineers are possible of execution in some time and at some cost. Sees no reason why a sea-level canal can not be completed in 10 or 12 years at the utmost; advances reasons to the effect that sea-level plan is better from almost every point of view. **P-06***, 360, 361.

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Division charged with the preparation of plans and estimates, and the construction and repair of all buildings on the zone. Task tremendous, in view of rigorous requirements of the sanitary department and the liberal policy of the Isthmian Canal Commission. 1,700 to 2,350 men in this division. Hardly a spot in the zone where it has not done work of importance, in the way of repairs, rebuilding, new houses, etc. **P-05,** 112.

At beginning of fiscal year bureau of architecture and building reorganized. Building material began arriving Sept., 1905; actual working force had increased to 3,150 men in Feb., 1906, when force began to decrease, because of lack of supply of requisite material. Tables showing classes of work done, type of houses, etc. Repair and construction done at long list of camps and points in the zone. Permanent residence for governor of the zone begun. Despite increase in housing accommodations, quarters for white employees never equal to the demand; provision for hotels, messhouses, post offices, schoolhouses, etc., constantly increasing in necessity; generally all new arrivals have been comfortably cared for; conditions steadily growing better. "It is believed that the provision which has been and is being made for the comfort and health of the employees of the commission has never been approached or attempted under similar circumstances and work." **P-06,** 99.

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Camps, Sick. (See Health)

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Canal, Lock. (See Board of Consulting Engineers; and Canal, Sea-Level.) (See p. 2365.)
Board of Consulting Engineers created by Executive order of June 24, 1905, to consider on proper type of canal, failed to agree. Two reports presented, Jan. 10, 1906. Eight members (5 foreign representatives) favored sea-level canal; 5 members (Americans) favored lock canal at elevation of 85′. Isthmian Canal Commission No. 3, to whom reports were referred, reported to Sec. of War, Feb. 5, 1906, in favor of lock canal, 1 member only dissenting. Civil Engineer Endicott, U. S. Navy, preferred sea-level canal. Isthmian Canal Commission No. 3 report, accompanied by report of Chief Engineer Stevens, in favor of lock-level plan. Sec. of War transmitted these reports to President Roosevelt, concurring in recommendation of lock-level work, Feb. 19, 1906, and on the same date President Roosevelt forwarded the reports to Congress, expressing concurrence in recommendations for a lock-level canal. On June 21, 1906, Senate, 36–31, authorized lock-level canal, as follows: "Be it enacted, * * * That a lock canal be constructed across the Isthmus of Panama connecting the waters of the Atlantic and Pacific Oceans, of the general type proposed by the minority of the Board of Consulting Engineers created by order of the President under date of January twenty-fourth (June twenty-fourth), nineteen hundred and five, in pursuance of an act entitled 'An act to provide for the construction of a canal connecting the waters of the Atlantic and Pacific Oceans,' approved June twenty-eighth, nineteen hundred and two." The House concurred, and on June 29 the act became a law. **P-06,** 13.

Canal, Panama (general data). (See No. 196, p. 2365 of this Index; see from p. 2361 to p. 2368 of this Index.)
Accounting system, Panama Canal, **P-04,** 55; **P-05,** 20.
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Act, Spooner, **P-11,** 550.
Building, preliminary organization, **P-05,** 150; **P-07,** 241.
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Completed Panama Canal, map, **P-12,** frontispiece.
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P-14, 61.

Canal, Sea-level. (See Canal, Lock; Board of Consulting Engineers.)
Estimate by Mr. Wallace. (See Culebra, Status of.) **P-05,** 144.
Discussion of views, **P-05,** 296.
Committee reported Feb. 14, 1905: "With the rate of progress which now appears reasonable to anticipate, this committee believes that a sea-level canal, with a tidal lock 1,000′ long and 100′ usable width, at Miraflores, can be completed within 10 to 12 years from this time, the bottom width of the canal being 150′ and the minimum depth of water 35′." Estimate, not exceeding $230,500,000. **P-05,** 299.
Moved at commission meeting that sea-level plan be approved. Subject referred to committee on engineering plans. **P-05,** 326.

Canal, Transformation of. (See Board of Consulting Engineers.)
Possible to make transformation from lock to sea-level type. Estimate for reducing a lock canal with a terminal lake on the Atlantic side formed by a dam at Gatun, with 3 locks on the Atlantic side and 3 on the Pacific, and with a summit level 85′ above mean tide, to a sea-level canal with the dimensions

of prism adopted for the sea-level plan, $208,985,000. Transformation impracticable from a financial standpoint of view. Date for needed change remote. Time required can not be expressed definitely. P-06*, 38, 220.

Canals, Capacity of.

For traffic. (See No. 177, p. 2355 of this Index.)

Suez Canal presents the nearest analogy to the case of the Panama Canal. Depth 31′ 2″ (being increased to 34′ 5″). Amsterdam Canal, Holland, has one pair of locks, 31′ 2″ by 82′ by 738′. Manchester Ship Canal, England, controlled by tidal locks 80′ by 600′. Depth at low water, 26′. Kaiser Wilhelm Canal, Germany, has tidal locks 32′ by 82′ by 492′. St. Marys Falls Canal, U. S., lock 25′ by 80′ by 1,400′ building. "A just estimate of the growth of traffic on the Panama Canal can not be formed from the statistics of the growth of trade on any existing waterway. * * * It is therefore essential that the Panama Canal should furnish a double road for traffic throughout, and we consider that the locks should be built in pairs; that twin locks should lie side by side, and that the different lengths of the canal should be of such dimensions as to permit two of the ordinarily large-sized commercial steamers to pass each other at any part of the journey." P-06*, 39.

Canals, Dimensions of.

After considering dimensions of various world waterways, "it is believed, therefore, that for many years the commerce seeking the Panama Canal will be amply accommodated by a depth of water not exceeding 35′." 150′ recommended as minimum bottom width, 35′ as minimum depth; but that estimates be prepared for a depth of 40′ as well. If lock canal be chosen, locks should be 100′ by 1,000′, fitted with intermediate gates. P-05, 300.

Dimensions of ships, channels, and harbors: Appendix C. Report of Board of Consulting Engineers. M. Adolphe Guerard. (Translated.) In 1900 tendency for larger vessels became pronounced. Enlarging of Suez Canal. Greater depths in large harbors. List of large ships building, and those existing, 1905. Large ships increasing among various classes. "The increase in the consumption of coal is out of all proportion with the increase in speed. * * * The development of works in maritime ports follows instead of precedes the dimensions of the steamers, for these works are very expensive when they attain the proportions necessary for the operation of large vessels." Increase of depth in harbors; depths of anchorages in English ports. "Should it be necessary in order to determine the dimensions of the Panama Canal to take into account the exigencies of navigation, we must not lose sight of the fact that navigation must shape its tools, the steamers, to conform with the sizes of the ports and canals." P-06*, 165–170.

Diagram of speeds through canal and locks. Summary of dimensions and speed of vessels. Plates XXIX and XXX. P-06*, 7.

Canals, Isthmian; physical characteristics.

(See Nos. 4, 5, 6, 7, 16, 20, and 21, p. 2361 of this Index.)

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COASTS: Panoramic views, Atlantic coast, Isthmus of Darien, P-99, pl. 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20.

CLIMATES: Damp and enervating. Temperature, 70° to 95°, but humidity excessive. Important factor in employing labor. Not much to choose between Nicaragua and Panama. P-99, 114.

DISCHARGE (see Routes, below): San Juan River (canalized), Nicaragua route, P-99, 273 (Appendix H). Special study, with map, tables, diagrams, P-99, 280. Lake Bohio, Panama route (Appendix E), P-99, 247. Study of waste weir dimensions and discharge, P-99, 247.

DRAINAGE (see Routes, below): Caledonia Bay to Rio Sabana, P-99, pl. 5.

EARTHQUAKES (see Volcanos, below): "No portion of it (Isthmus) exempt from earthquakes. No very important earthquake at Panama or Nicaragua since 1886." P-99, 112. Mechanical action of earthquake, P-99, 113. "A force which would leave the foundation intact might throw down a high wall." "The works of the canal will nearly all of them be underground." "The locks will all be founded upon rock." Probable that lock gates may be distorted, but such an event to be classed with injuries, such as made by collisions, etc., and to be cared for in a similar way, etc. P-99, 114. A fissure probable, draining canal, but such an occurrence in a class with an unwonted conflagration. "If a timorous imagination is to be the guide, no great work can be undertaken anywhere." P-99, 114.

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HYDROGRAPHY OF NICARAGUA (Appendix I). R. by A. P. Davis, chief hydrographer.

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RAINFALL (see Hydrography, above): Zones of, Panama route, P-99, pl. 71. Nicaragua, P-99, pl. 72, 73.

ROUTES: Possible routes, P-99, 49. American Isthmus 1,400 miles long, embraces that portion of the Republic of Colombia west of the Atrato River, the whole of the 5 Republics which are grouped together as Central America, and so much of Mexico as lies east of Tehuantepec. General direction of the Isthmus is from se. to nw. For the entire 600 miles the width of this Isthmus is comparatively small, varying from a minimum of barely 30 miles to a maximum of 120 miles. It then widens to 300 miles near the boundary between Nicaragua and Honduras, narrows to about 120 miles opposite the Bay of Honduras, widens again into the great peninsula of Yucatan, and finally narrows to 120 miles at Tehuantepec.

A glance at the map appears to indicate that the only possible routes for an interocean canal must be at Tehuantepec, at the Bay of Honduras, or within the eastern 600 miles. While Tehuantepec is admirable for a ship railway, this route, on account of the probability of poor water supply, cost of locks and the number of them, together with the additional cost of the canal proper, must be considered impracticable, in spite of its convenience of approach and accessibility on both sides by the U. S. P-99, 49.

The next point is the Bay of Honduras. It is a mountain region. Out of the question. P-99, 49.

Within the limits of the 600-mile stretch at the eastern end of the Isthmus several routes have been proposed. At the western limit of this stretch is Lake Nicaragua. With the exception of Nicaragua and Tehuantepec, all the routes proposed for an isthmian canal terminate in the Gulf of Panama or on the South American coast south of that Gulf, the latter using the Atrato for their Atlantic approach. P-99, 49, 50.

The Atrato rises near the 5th degree of north latitude, flows northward about 300 miles, at a comparatively short distance from the Pacific and parallel to it. It is a silt-bearing river having a considerable fall, and not adapted to the passage of ocean craft without large expenditure for improvement and maintenance. **P-99**, 50.

The routes most talked of for years, terminating on the Gulf of Panama, are: The Panama route, the San Blas route, and the Caledonia route. The Panama, the most westerly of the three, in use for years by means of the Panama R. R.

The chief difficulty of the San Blas route lies in the height of the summit, to cross which tunnels 8 to 10 miles long have been proposed, **P-99**, 51.

The Caledonia route is the location whereby the isthmian way was first crossed by white men. Peterson chose this location for his Scotch colony in 1698, 200 years after Balboa crossed. All vestiges of white men's labors here have disappeared. "It would be hard to find any spot in America where there are fewer signs of the work of the white man." Careful examinations and surveys show the improbability of the existence of any practicable canal location between Panama and the mouth of the Atrato, except by the adoption of a tunnel line, the objections to the latter being obvious. There are three probable tunnel routes via the Caledonia route. Cost of tunneling, per mile, about $22,500,000.

A tunnel via the San Blas route would be at tide level. Engineering cost, including 4.2 miles of tunnel, $289,770,000. Length of the line would be about 37 miles.

Length of line by Caledonia route, about 30 miles. Tunnels, of three routes, would be at tide-level canals. Engineering cost, $263,340,000, $283,440,000, or $320,040,000.

The only restriction on the length of a ship passing through tunnels would be the curves. The tunnels would be as absolute restrictions on depth and width as the locks of Nicaragua or Panama.

The only advantage such lines of passage would have over a tide-level line at Panama would be in the superiority of their Atlantic harbors, Mandinga Harbor in San Blas Bay, and Caledonia Bay; not enough to overcome the disadvantage of a tunnel, **P-99**, 50, 51, 52, 53, 54, 55.

General map of Central American Isthmus, Tehuantepec to Buenaventura Bay, **P-99**, pl. 1. Map of Panama route, **P-99**, pl. 21.

Details, Panama route, **P-99**, 56.

Panama route: Narrow isthmus, low summit, width less than 36 miles in a straight line, only 5 miles more than at San Blas, the narrowest place. High portion of the Isthmus limited to a width of about 6 miles near the Pacific side. Chagres River affords access by canoe navigation from the Atlantic to within 16 miles of the Pacific. Steamship lines to California discharge their passengers at the mouth of the Chagres; conveyance up that river, thence overland to Panama. Panama R. R. made its Atlantic terminus at Bay of Limon, 7 miles east of the Chagres mouth. The road follows the valley of the Chagres to Obispo, and thence crossed through the lowest gap to Panama. (Location almost identical with that adopted for the canal.) **P-99**, 56.

At Colon, the Atlantic port, tide range about 1′; at Panama, about 20′. Colon Harbor exposed to "northers"; ships sometimes compelled to go to sea. **P-99**, 56.

Map of San Blas route, **P-99**, pl. 3, 4.

Map of route Caledonia Bay to San Miguel Bay, **P-99**, pl. 6.

Details, Nicaragua route, **P-99**, 71.

Nicaragua route: Water communication by means of a large river and lake from the Atlantic to within a short distance of the Pacific accentuates the natural advantages of this route, "and at the same time tends to exaggerate them and to obscure the attendant difficulties," **P-99**, 71.

Lake Nicaragua, about 103 miles long; maximum width, 45 miles; area, about 3,000 square miles. Its longer axis is parallel to the Pacific coast; resembles Lake Erie somewhat in shape, but has only about one-third the latter's area.

First instrumental survey made by Nicaragua Canal Commission, 1898; found that bottom of the lake is above sea level over the greater part of its area. Maximum depth about 200′, found just south of the island of Ometepe, which has an elevation of 5,000′. **P-99**, 71.

About 18 miles to the northwest of Lake Nicaragua, on a prolongation of its axis, lies Lake Managua, extending a distance of 37 miles toward the Gulf of Fonseca, a large, natural harbor opening to the Pacific Ocean **P-99**, 71.

Lake Managua is drained through the river Tipitapa, which is frequently without water in the dry seasons. The lake is 65 miles from the Gulf of Fonseca. A shorter route from Lake Managua to the Pacific crosses the plain of Leon to the Bay of Corinto, about 35 miles in an air line. **P-99**, 71.

Surface of Lake Nicaragua a little more than 100′ above sea level. Mr. Menocal in his 1885 report says that the lake was as high as 110.63′ above mean sea level at the end of the wet season of 1878. It has been as low as 97′ or less. Extremes reached at long intervals. In 3 years' consecutive observation, fluctuations only 6.09′. **P-99**, 71.

The drainage basin of the lake is in great part mountainous. Continental Divide, formerly on eastern side, now between the lake and Pacific. Col. Childs, 1850–1852, developed the lowest crossing, crossing the divide at an elevation of only 153′ above mean tide and following the valley of a small stream called the Rio Grande to the Pacific at Brito. **P-99**, 71, 72.

Lake Nicaragua discharges through the San Juan River at Fort San Carlos, follows a tortuous course in a southeasterly direction, and empties through several mouths into the Caribbean Sea near Greytown. Distance from lake outlet to mouth about 80 miles air line, but 120 by windings of river.

The Indio, which empties into the Caribbean some 6 miles northwest of Greytown, runs parallel to the San Juan, the headwaters of some of its tributaries being only about 15 to 20 miles distant from that river.

The San Juan has a number of tributaries, none of great size, save, perhaps, the San Carlos, the Serapiqui, and the Negro. In flood times the discharge of all these streams affects the San Juan. When the San Carlos is in flood the San Juan current may set upstream. **P-99**, 72, 73.

San Juan: Slopes in various reaches; table, **P-99**, 73.

Below the mouth of the Serapiqui the San Juan River enters the coastal plain, a region of swamps, bayous, and lagoons. About 20 miles from the sea it divides into two outlet branches—the lower San Juan, which discharges through Harbor Head Lagoon near Greytown, and the Colorado, which discharges directly into the Caribbean, about 15 miles to the southward, forming the principal outlet. **P-99**, 74.

Trade winds blow almost constantly; not believed that the winds would seriously interfere with canal navigation at any time, **P-99**, 74.

Along the Atlantic coast in the vicinity of Greytown and for some distance inland the rainfall is the greatest known on the Continent. There is no definite dry season. Rain may be expected any day of the year. On the other hand, the entire drainage basin of Lake Nicaragua lies in a region having a well-defined dry season. The average rainfall near Greytown sometimes amounts to nearly 300″. In the drainage basin of Lake Nicaragua the average rainfall is about 65″. **P-99**, 74.

Geology: Indications of a general subsidence of the Atlantic coast in the region of the Nicaragua route. The former rocky bed of the San Juan appears to have been depressed. At the dam site adopted by Isthmian Canal Commission No. 1 at Conchuda the distance from the low-water surface to the lowest point in the rock cross section is about 80′. From the mouth of the San Carlos down is a deep rocky trough, which is filled with sand. In the coastal plain, consisting mainly of swamps, vegetable matter intermixed with silt is found to a considerable depth, but within 5 or 6 miles of the coast sand is found extending to a great depth under a light covering of mud. **P-99**, 74.

Attractive· favorable transisthmian route immediately after the discovery of gold in California. Passengers arriving by sea at the port of Greytown, at that time an excellent harbor, were transported by steamboats to the west shore of the lake; whence the Pacific was reached by a short stage line, which terminated at the port of San Juan del Sur. Successive projects for interoceanic communication have had to provide for the increasing dimensions of ships; the serious difficulties nearly all found between Machuca Rapids and the Caribbean. **P-99**, 75.

The region of practicable canal routes is limited to the north side of the San Juan River, by the existence of the San Carlos and Serapiqui Rivers on the south side. Financially it would be impracticable to divert these streams, and it would be equally impracticable to take them into the canal. Hence, all the surveys and examinations for a canal route have been confined to the north side of the river. **P-99**, 75.

Topography of the country in the vicinity of the route generally rough. Hills of medium size bunched and steep; swamps between them. Dense tropical vegetation; few places where transit line can be run 50′ without cutting out a line of sight; this accounts for paucity of information.

From Greytown to Castillo the boundary line between the Republics of Costa Rica and Nicaragua follows the right bank of the San Juan. Thence to the lake the boundary is a line on the right bank, generally about 2 miles from the river. Both shores from Castillo to the lake are therefore in Nicaraguan territory. In case the level of the water of the river is raised by the construction of a proposed dam at Conchuda, some of the lands in Costa Rican territory would be submerged, although the canal line proposed from Castillo westward to the Pacific would lie wholly in Nicaraguan territory. **P-99**, 75.

Greytown Harbor; old maps; map of 1832; hydrographic charts of Great Britain; trend of coast; outlets of San Juan; sedimentary deposits; effect of wave action on coast; movement of sand spit; erosion or accretion dependent on direction of waves and sand supply; reentrant angle; apparent recession of 8-fathom curve, of 6-fathom curve; how to stop westerly drift of sand; construction of harbor feasible, **P-99**, 92, 93, 94.

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General map, Nicaragua route, **P-99**, pls. 28–47.

TOPOGRAPHY, Caledonia Bay to Rio Sabana, **P-99**, pl. 5.

VOLCANOES (see Earthquake, above): Central America, **P-99**, 112; pl. 70.

WATER COURSES: Isthmus of Darien, **P-99**, pl. 2.

Canals, World-famous.

Relative efficiency of, considered in report of Isthmian Canal Commission No. 3 on question of lock or sea-level canal for Panama. Most important ship canal in the world that at Sault Ste. Marie, Mich. Tonnage there per annum 3 times that carried by the Suez Canal, and is greater than the aggregate tonnage of

  Suez, Manchester, Kiel, and Amsterdam Canals combined. One of its locks the largest in existence; in successful operation since 1896. Majority of Board of Consulting Engineers have attempted to belittle this experience. Isthmian Canal Commission No. 3 majority did not concur in opinion also that a lock properly constructed and managed "is in any sense a menace to the safety of vessels." "Practical experience has demonstrated the contrary beyond dispute." **P-06***, xiv.
  Canals of the world: Description of, with plates and cross sections. Appendix D. Report of Board of Consulting Engineers. **P-06***, 171–184.
  The Manchester Ship Canal. By W. H. Hunter. Depth of water, width at bottom, inclination of side slopes, proportion between sectional areas of canal and vessels navigating canal, curvature.
  The Kaiser Wilhelm Canal (Kiel Sea Canal). By E. Tincauzer.
  The North Sea Canal. By J. W. Welcker.
  The Suez Canal. By E. Quellenec. Depth of water, bottom width, inclination of slopes, cross sections, authorized draft, speed of ships, currents, proportion between sectional areas of canal and areas of midship sections of vessels, curves.
  St. Marys Falls Canal. By Joseph Ripley. Curvature, side slopes.
  The Corinth Canal. E. Quellenec.
  Dimensions of the canals of Europe. A. Guérard.

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  Appliances for handling, **P-12**, 218.
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  Table of elements of the zone population, **P-06**, 79.
  Executive order relating to, **P-12**, 613.

Central Division. (See No. 241, p. 2367 of this Index.) (Takes in the former Culebra and Chagres divisions.)
  1909. Duties: Embraces all the excavation between the Gatun Dam and Pedro Miguel, including the diversion channels; construction of the Naos Island breakwater; clearing of timber from the channel and anchorage basin; and such municipal, sanitary, and building work as may be included within the district limits.
  In charge: Lt. Col. D. D. Gaillard, Corps of Engineers, U. S. Army, as division engineer. **P-09**, 10.
  Culebra section: Limits, from Chagres River in the vicinity of Gamboa to Pedro Miguel. Plan, originally contemplated channel 300′ wide at the bottom, save for the portion between Las Cascadas and Paraiso, where the width was fixed at 200′. Oct. 23, 1908, the President authorized the widening of this portion so that the minimum bottom width throughout should be 300′.
  Diversions: Excessive rainfall; adjacent streams rise rapidly. Obispo diversion, caring for drainage on east side, completed June 1, 1909. Carries water into the Chagres about ½ mile east of Gamboa. Required excavation of 1,132,000 c. y. (two-fifths rock), and dike construction totaling about 1½ miles.
  Drainage: Water which falls within the prism, etc., cared for by the cut itself, through means of pilot cuts. Bed of canal at crossing of Chagres River at plus 40; excavation at grade. Dike of natural surface left. Pipes laid through dike for drainage; and pumping plant under way.
  Excavation: Widening of top areas sufficiently to secure the required bottom width practically completed. Excavated from the prism during the year, 18,442,624 c. y., place measurement (12,291,472 c. y. rock). At the close of the year 43,574,954 c. y. remained to be removed in order to complete the canal.
  Dumps: Various dumps in vicinity of cut abandoned, as they became uneconomical; toward close of year practically all material hauled to dumps at Tabernilla, Miraflores,

Balboa (formerly La Boca), and along the line of the relocation of the Panama R. R. between Caimito and Gamboa. Rock from vicinity of Bas Obispo and Empire was still hauled to Gatun for the dam. Completion of the Gamboa bridge gave access to the line of the heavy embankments to be built on the relocation, and 14,731 linear feet of trestle filled.

Filling: 145 acres reclaimed east of the Panama R. R. wharves at Balboa, with dumpings.

Naos Island breakwater: Dumpings used in building. Object of breakwater, to cut off silt-bearing currents approaching or crossing the excavated channel in the Pacific, thereby reducing the cost of maintenance. Extended out approximately 2 miles; upward of 3,000,000 c. y. deposited from trestle; 1 mile to be done.

Slides: Continue as a source of annoyance. Cucaracha slide extended northward until it joins one just south of Gold Hill. Measures 2,700′ along the cut, involving area of 27 acres. Total amount removed for the year, 670,017 c. y.; 700,000 c. y. still in motion. Drainage by the French to prevent slide of no benefit. New Culebra slide next largest. 125,000 c. y. in motion. Other slides. During the year 884,530 c. y. removed from all; estimated that 1,000,000 c. y. still in motion.

Explosives: Number of accidents small; casualties large. Experiments to gain best methods. Electric-light current used for exploding, and firing by fuses in parallel. Danger of unexploded charges found by steam shovels practically eliminated.

Lake section: Limits, extends from Gamboa to Gatun. Formerly constituted the Chagres River division. Chagres River course: Crosses the line 23 times, forming peninsulas numbered as Point 1, Point 2, etc., beginning at Gamboa. Dredging across Points 1 and 2; waters of Chagres turned in June 9 at Point 2; total of 1,784,459 c. y. excavated, 1,350,308 removed during fiscal year. Gravel in large quantities brought into new cut by floods; will be removed by dredges or by drains and utilized for making concrete to revet slopes of Culebra section. Changing course of river permits old bed to be used as a dump. Cutting across Point 3 begun June 12, 1909. At Caimito excavation was begun Oct. 1, 1907; during fiscal year 1,375,599 c. y. removed. At San Pablo excavation continued until Jan. 4, 1909. During the year 558,077 c. y. removed; 220,182 c. y. remains to complete the peninsula. Cano River cut: On west side of Chagres River, nearly opposite Tabernilla. Work begun Dec. 15, 1908; 583,867 c. y. removed. Isolated knolls: Above bottom grade of the canal, vicinity of Bohio. 107,740 c. y. removed; 88,000 c. y. remained for removal.

Buena Vista: Work started near, on right bank of Chagres, to secure necessary width and depth of channel.

Anchorage basin: Flat area south of the Gatun Hills. Clearing of it begun, and the channel, to elevation 15; roots grubbed, and a total of 1,256 trees cleared. In the channel from Gatun to mile 13, trees cut down over an area of 458 acres, removing all standing timber from the channel 1,000′ wide. Between miles 26 and 27, in the vicinity of Mamei, 43 acres were also cleared. P-09, 10, 11, 12, 13, 14.

Municipal, building, and sanitary work: Water supply; 15,560′ pipe laid in extension. Sewer system, 5,894′ laid at various settlements; 59 house connections made. Bridges; suspension bridge begun at Empire. Roads; constructed in vicinity of Culebra, Empire, Gorgona, Bas Obispo, San Pablo, and Tabernilla. Buildings; number of various kinds put up; repairs made. Sanitation; 24,370 linear feet open ditches laid; tile drains and filling. Existing drains maintained. P-09, 14.

1910. Five construction districts consolidated into four, as follows: Chagres River district, Gatun to Chagres River at Gamboa; Empire district, Gamboa to Empire suspension bridge; Culebra district, Empire suspension bridge to railroad crossing north of Pedro Miguel Locks; and Pedro Miguel district, embracing excavation between railroad crossing and locks, dumps south of Pedro Miguel, and construction of Naos Island breakwater. Division includes Culebra Cut proper, Gamboa to Pedro Miguel.

Chagres district: Work on Point 1 commenced Feb. 24, 1908, continued until June 15, 1909, when, because of high water, work discontinued; resumed Jan. 20, 1910; excavation at this point completed May 28, 1910; 286,560 c. y. taken out. Total removed from Point 1, 1,246,761 c. y. Point 2, between Matachin and Gorgona, completed May 25, 1909. Bottom of the cut was between 2 and 3′ above bottom of Chagres River at a point where the latter crosses the cut, and heavy floods of Nov. and Dec. deposited about 109,000 c. y. gravel. Steam shovel and orange-peel crane put at work to collect this gravel for use as ballast and roads; 56,238 c. y. removed and stored. In consequence of this supply, crushing plant at Bas Obispo put out of service. Point 3 lies on east side of Chagres River opposite Gorgona; excavation begun June 12, 1909; continued until close of year; 832,646 c. y. removed. There remained 157,522 c. y. to complete this section, but as every slight rise of Chagres River stops work, it became necessary to remove tracks and shovels. Remaining material loosened by blasting; hoped that floods of Chagres will remove it; such as may remain will be taken out by dredges. Point 4 lies on left bank of Chagres at Gorgona; excavation begun June 2, 1910; 10,646 c. y. removed. Point 5 at Juan Grande; excavation commenced June 2, 1910; 23,824 c. y. removed. Point 6 north of Juan Grande; work commenced May 2, 1910; 46,741 c. y. removed. Handwork at Point Mamei commenced Apr. 15, 1910, and excavation by steam shovel June 15; 8,315 c. y. removed.

At Mamei work commenced Sept. 17, 1909; 372,671 c. y. removed. Excavation at Caimito in progress at close of the last year continued, removing 338,675 c. y.; completed the work in this locality on Apr. 22, 1910. Total excavation at this point, 2,268,572 c. y. During the year 5,899 c. y. removed from San Pablo section, which leaves 258,000 c. y. remaining. Cano River section on west bank of Chagres nearly opposite Tabernilla. Work begun Dec., 1908; completed Sept. 24, 1909; total removed, 707,031 c. y. Work commenced at Tabernilla Nov. 13, 1909, and carried forward to June 17, 1910; 392,490 c. y. removed. Near Buena Vista, on right bank of Chagres, are 2 hills, parts of sides of which had to be removed to give channel necessary width and depth. Work commenced June 29, 1909; completed Nov. 10, 1909, by removal of 153,026 c. y., transported to and dumped in toes of Gatun Dam. At Bohio, steam-shovel work consisted in removing rock hill near north end of village; commenced Sept. 4, 1909; completed Nov. 10, 1909; 33,874 c. y. removed. Isolated elevations projecting but short distance above proposed level of bed of canal removed by employees or by contractors. That done by Isthmian Canal Commission commenced Jan., 1909, completed Nov. Total excavated in vicinity of Bohio, 184,148 c. y. Contract made for removal of 160,947 c. y. from prism between San Pablo and Bohio; all removed excepting 14,223 c. y. Contract entered into for excavation of 202,410 c. y. between Tabernilla and Bohio. Third contract entered into Feb. 10 to excavate 397 c. y. on miles 14 and 15 and miles 19 and 20; finished Mar. 15. Total amount removed from Chagres section from 1907 to close of the last year, 9,497,673 c. y., leaving estimated amount of 3,415,944 c. y. This amount increased over estimate of Sept., 1908, by 251,965 c. y., for excavating to elevation 39 above sea level instead of 40, made necessary by floods, and by allowing 670,000 c. y. for silting. Clearing, grubbing, and burning of trees in channel of Lake Gatun commenced; 950.4 acres cleared.

Culebra Cut: During the year 14,921,750 c. y. excavated, leaving 34,893,531 c. y. The remaining amount includes increase of 6,408,560 c. y. over estimate of Sept., 1908, due to widening canal north of Pedro Miguel Lock to form basin, adding thereby 932,572 c. y., and to allowing 5,475,988 c. y. for slides and breaks, as new ones developed during year.

Previous to fiscal year movement of material into prism due almost entirely to slides caused by movement of top layer of clay upon smooth sloping surfaces of rock or other material harder than clay. In addition, several breaks occurred in banks. Of the slides proper, most important at Cucaracha. Total area embraced since commencement of operations, 47.1 acres. Prior to July 1, 1909, 1,125,017 c. y. material removed from this slide, and 639,239 c. y. removed during fiscal year. Next largest slide is on west bank where New Culebra was located, caused by movement of large French dump into canal. Area involved, 7.3 acres. Prior to July 1, 1909, 118,024 c. y. removed, and 327,540 c. y. removed during year. Third slide covers 4.6 acres, and is on east bank directly opposite Whitehouse yard. Prior to July 1, 1909, 50,800 c. y. removed, and 110,000 c. y. reremoved during present year. Fourth slide covers 1.7 acres on east bank of the Obispo diversion at La Pita Point, where west slope of a hill broke away and commenced to slide toward Obispo diversion; 15,608 c. y. taken away. Three bad breaks occurred during year. On west bank at Culebra break covers 10½ acres, and during year 1,500,388 c. y. removed, making a grand total of 1,680,000 c. y. since break began. Second largest break, directly opposite that just described, covers 11½ acres on east side of canal; during year 314,184 c. y. removed, making total from this locality 480,202 c. y. Third break was at La Pita Point, and permitted waters of the Obispo diversion to flow into canal for three days, drowning out some shovels at north end. Break aggregates 40,000 c. y. Flume constructed to carry flow of diversion past break. Total removed from slides and breaks in central division during year, 2,649,563 c. y., or 15 per cent of amount removed from Culebra Cut.

Floods seriously interfered with progress of work, and one of Dec. 26 overflowed dike separating cut from Chagres, cutting channel 200′ long and 21′ deep. Steps taken to rebuild it; accomplished, and dike maintained through flood of Dec. 30. Subsequently it was strengthened and carried to elevation of 73 at top of rail. Track on dike connects relocated line at Gamboa with main line of Panama R. R. at Matachin. Pump with capacity of 18,000 gallons a minute ordered to be added to those already in north end of cut to handle water accumulating.

During year 17,749,306 c. y. deposited in various dumps. Most important of these at Tabernilla, relocated Panama R. R. between Gamboa and Caimito, Miraflores, and at Balboa. In addition, over 1,150,000 c. y. removed from Culebra Cut taken to Gatun and deposited in toes of dam. Several dumps opened in Chagres section. Material deposited at Tabernilla and Miraflores outside of relocation of railroad wasted. That dumped on Panama R. R. relocation is used for filling trestles and for raising embankments; 2,351,334 c. y. useful for this purpose. Material deposited at Balboa is useful in that land is reclaimed from ocean, which will be valuable; 108 additional acres reclaimed, making total of 253 acres.

Breakwater started from Balboa toward Naos Island with object of cutting off silt-bearing currents from excavated channel in Pacific, thereby reducing cost of maintenance, and making navigation easier by protecting vessels from cross currents. During year trestle extended 1,123′, giving a total length from shore of 2.4 miles. End of trestle was within 4,900′ of Naos Island, and the filling extended to within 400′ of end. Trouble experienced in extending outer end of dike, due to sliding of bottom when weight of stone filling was dumped from trestle. Sliding has taken place at every foot of the last 4,000′ of dike, and continual settlement of roadbed for 2 or 3 months, after which it gradually diminishes.

Empire shops: On Nov. 5, 1907, a force of mechanics was organized to work in the cut at night in repairing steam shovels. Repairing of steam shovels and manufacture and repair of steam-shovel parts for entire canal transferred to central division, Oct. 1, 1909, when Empire shops were transferred from mechanical division and all other mechanical work formerly handled at Empire shops transferred to Gorgona shops.

Municipal work: Road 8′ wide constructed from Empire to Las Cascadas plantation, 2.6 miles, completed Oct. 31. Road between Empire and Paraiso continued, 75 per cent completed June 30. Road between Empire and Gorgona 52 per cent completed. Suspension bridge at Empire completed July 31, 1909. Sanitary work consisted of constructing 17,149 linear feet of ditches, regrading 116,028 linear feet of ditches, cleaning 1,453,841 linear feet of ditches and 56,441 linear feet of concrete drains, laying 7,289 linear feet of tile drains, constructing 56,441 linear feet of concrete gutters, and clearing 123,597 sq. y. **P-10,** 14–20.

1911. Chagres district: The material which remained to be removed July 1, 1911, in Point 1, consisted of gravel and sand washed in by the Chagres River; 20,455 c. y. removed and taken to storage piles. Point 2: Of gravel and sand, 46,102 c. y. removed. Point 3: 91,278 c. y. washed away by freshets. Point 4: 828,462 c. y. removed by steam shovels. Point 5: 438,241 c. y. removed, completing section. Point 6: Section completed Oct., 1910, by which time 112,238 c. y. had been removed by steam shovels. At East Mamei: 598,213 c. y. removed by steam shovels; work at this point completed Mar., 1911. At Mamei: 10,0[illegible]6 c. y. removed by steam shovels, July, 1910, completing work. At Tabernilla: 51,970 c. y. removed in Feb. and Mar., 1911. At Caimito: 731 c. y. removed in Mar., 1911, completing work. Of contracts, that between San Pablo and Bohio completed by removal of 13,832 c. y. making total removed, 170,808 c. y. Contract for removal of 202,140 c. y. from prism between Tabernilla and Bohio still in progress, contractor removing 105,532 c. y. during year. Contract entered into Dec. 6, 1910, for excavating 112,450 c. y. from canal prism between stations 28–1000 and 28–2300. Work begun Dec., 1910; by close of year 58,904 c. y. removed. Total removed from Chagres section during the year aggregated 2,301,020 c. y., leaving on July 1, 1911, to complete this portion 533,921 c. y. Excavation in Chagres River section 95.68 per cent completed June 30, 1911. Clearing, grubbing, and burning trees in channel of Gatun Lake by hired labor commenced at beginning of dry season; 182 acres of trees and brush cut in vicinity of Chagrecito and Bohio; completes all clearing of channel throughout central division. In connection with lighting and buoying canal this division cleared 373.5 acres and cut 67,550′ of trocha for running profiles.

Culebra Cut: During the year 16,221,672 c. y. excavated; estimate again increased over that reported a year ago by 4,676,278 c. y., to allow for slides developed beyond the limits assumed in the preparation of former estimates. Total removed during the year outside of slope lines and because of slides aggregated 4,879,378 c. y., or 30.07 per cent of total amount of material removed from cut, as against 15 per cent during previous fiscal year. Thus far 10,757,658 c. y. of material due to slides removed. In addition to the slides, breaks have occurred, notably on both sides of the cut at Culebra. Rational method of treatment seemed to be to relieve or reduce the pressure as much as possible, and work along these lines was directed in the latter part of the dry season on the west side of Culebra Cut, and has been so successful that a point has been reached so that the shovels at the bottom are not interfered with, and are enabled to move ahead without bulging due to pressure from this side. Intermediate benches along the slope are cut so as to distribute the top weight and reduce amount of material that may have to be removed. Work was started similarly on east side along same lines. Geological formation of the Isthmus is very irregular and the character of material encountered in the cut is constantly changing, so that it is impossible to determine in advance where slides and breaks are liable to occur, or, when they do occur, the slopes which they will ultimately assume. Estimate of the amount remaining due to slides may not be reached; it may be exceeded.. To be noted that 6 of the good-sized slides which have given trouble in the past now quiet, with no indication of further movement, and the work of deepening the cut and widening the lower reaches has progressed satisfactorily with less interruption or interference on account of slides than at any time since trouble with them began. Increases in estimates of material to be removed made necessary by the slides will cause no increase in the total estimated cost for Culebra Cut, due to the reduction in the unit cost of the work; no indication that such increases will delay time of completing the work, because progress greater than expected, and by working on the upper reaches of the slopes the output maintained. The slide of greatest importance was that at Cucaracha, 47.1 acres. To July 1, 1911, 2,722,164 c. y. removed, and there remain 400,000 c. y. Last shovel cut at foot of Cucaracha slide made in first part of June, 1911, on the permanent berm at 95′ level, since which time there has been no sign of any movement, the slide apparently being "dead." Next largest slide was the Culebra slide, first reported as covering 7.3 acres; now covers 46.6 acres; at present most troublesome. On east bank opposite Culebra estimated 2,329,784 c. y. had been removed, and there remain 1,664,350 c. y. On west bank 3,714,562 c. y. have been removed and there remain 3,391,300 c. y. The other slides have diminished in importance.

The summit of drainage in the cut at Empire, and water entering to the south of this point drained into Pacific Ocean by pumping from sump at Pedro Miguel. Eight pumps of various types available on the Isthmus utilized having capacity of 38,250 gallons per minute. Arrangements in progress for draining through center culvert of Pedro Miguel Locks, which will eliminate pumps at this end, and gravity drainage south of summit will result. Dike separating cut on north side from Chagres River remained intact. Additional pump installed and water flowing to north of summit drained to sump at Bas Obispo end of cut, from which it was pumped into Chagres River. There are 8 pumps of various types, having total capacity of approximately 59,290 gallons per minute. As already noted, Obispo River broke into the canal through break at La Pita Point; at that time water checked and handled through a wooden flume, until Jan., when reinforced concrete flume 7′ high, 22′ wide, and 400′ long was commenced and completed in Apr. Flume has maximum discharge capacity of 3,000 cubic feet per second, or 15 per cent more than the greatest recorded flow at this point. Slide on east side of canal opposite White House, in Oct., 1910, broke back to Obispo diversion dike. New channel cut through a saddle so as to carry waters about 1,000′ farther from canal at this point, necessitating excavation of 22,416 c. y.

As depth of the cut has increased, egress for dirt trains more and more limited, resulting in decrease in dumps that could be economically utilized. Trains run from south end of cut at Pedro Miguel to dumps at Balboa and Miraflores, and from north end of cut to Gatun Dam, Tabernilla, and over the Gamboa Bridge to dumps on Panama R. R. relocation. Several new dumps of limited capacity opened in Chagres section to take care of local excavation. Tabernilla dumps closed after Dec. 12, 1910, and on them were wasted 1,008,098 c. y. during part of the year; at Miraflores, 3,478,706 c. y. wasted; and 4,646,841 c. y. dumped at Balboa in reclaiming land from ocean and in raising part of area previously reclaimed. Additional 62 acres reclaimed during year, making total area 315 acres. Material delivered at Gatun for the dam, back fill for the locks, and large stone for the concrete, 2,230,438 c. y., car measurement, and consisted of "run of the cut." Greater part of material hauled out on relocation of Panama R. R. between Caimito and Gamboa wasted; 3,509,221 c. y. disposed of over this section. Average haul to dumps, 12 miles. Two new methods of disposing of material devised; one by washing material to cause it to slide into Chagres River, which washed it away; and the other by so dumping from trestle as to utilize current of river in carrying away material dumped therefrom.

During year breakwater trestle extended 2,006′ so that trestle was 2,737′ from Naos Island. Filling extended to within 1,500′ of end of trestle, or 4,237′ from island. Trouble experienced in extending outer end of dike, due to sliding of bottom caused by weight of material dumped from trestle. This sliding encountered at every foot of last 4,000′ of dike and resulted in settlement of roadbed, which continued for first two or three months, after which it gradually diminished and finally ceased. The work of material benefit to channel.

At close of year Culebra Cut was 73.25 per cent completed. Empire shops continued under charge of the central division, making shop repairs and manufacturing repair parts for the steam shovels in use on the canal. Shovels repaired during year, 35. Night gang for field repairs maintained. Two oil furnaces installed in blacksmith shop.

Municipal work: Road between Empire and Paraiso, in progress during previous year, completed Oct. 1, 1910, resulting in highway 12′ wide and 18,800′ long. Road between Empire and Gorgona completed June 28, 1911, giving highway 12′ wide and 16,810′ long. Reinforced concrete bridge constructed to carry road over Mandingo River near Bas Obispo. It is 12′ wide and 196′ long, containing 556 c. y. concrete. As result of this work wagon road opened up from Panama City to Gorgona. Apr., 1911, work commenced on Empire-Chorrera road. One mile of subgrading, with necessary culverts, completed. Road from West Culebra to Cowpens, 3,200′ started in May, 1911, and by June 30 about 75 per cent completed. In Golden Green, a settlement between Empire and Culebra, 1,600′ of street macadamized. Sixty miles of trails cleaned and drained, the labor being done by natives working out poll taxes. Repairs made to existing roads and cinder paths. Water pipe laid, removed, and relaid aggregated 24,684′, and sewers laid, removed, and relaid aggregated 8,827′.

Sanitary work consisted of digging 7,177 lineal feet of ditches, regrading 291,474 lineal feet of ditches, cleaning 1,707,517 lineal feet of ditches, laying 1,762 lineal feet of tile drains, constructing 5,445 lineal feet of concrete gutters, cleaning 99,515 lineal feet of concrete drains, and clearing 58,501 sq. y. of brush and grass. **P-11.** 15-21.

1912. In Point 1,91,300 c. y. were removed, of which 27,632 c. y. were taken from prism. Gravel removed was stored for use as ballast and in concrete work. Total in storage at close of year, 110,000 c. y. At Point 4-B 56,350 c. y. removed; of this, 44,184 c. y. taken out by contract. Contract entered into Dec. 6, 1910, for excavating 112,450 c. y., but little done. Work begun Dec., 1910, and on May 16, 1912, after removing 108,992 c. y., contractor signified his inability to finish. Work was taken over and 12,196 c. y. removed by central division. At San Pablo completion of channel required removal of bed of old line of Panama R. R., which could not be done until line was abandoned. Work commenced Jan., 1912, completed in May by removal of 305,291 c. y., which finished prism. At Tabernilla excavation commenced Mar., 1912, and finished same month by removal of 22,893 c. y. At Buena Vista 100 c. y. removed in Mar., completing this part. At Bohio steam-shovel excavation commenced Feb., 1912, and finished Mar.; 6,997 c. y. removed. At Pena Blanco 48 c. y. removed Mar., 1912. Contract for removal of 202,140 c. y. between Tabernilla and Bohio entered into Mar. 21, 1910. Work commenced Oct., 1910; contract completed Apr., 1912, by removal of 207,132 c. y., of which 101,600 c. y. removed during year. Excavation of Panama R. R. embankment across anchorage basin south of Gatun commenced Mar., 1912, and finished to grade 35′ above sea level in following month; required removal of 39,568 c. y. Small force engaged in blasting stumps and trees in Gatun Lake Channel. Prior to Aug. 31, 1911, this division also did clearing work for first division in connection with lighting channel. Total clearing, 652.7 acres, involving running 49,547′ of profile and cutting 163,310′ of trochas. Subsequent to Aug. 31 this work handled by forces under the first division, O. C. E. Total removed in Chagres section during year, 560,509 c. y., leaving 151,000 c. y. of wet excavation remaining.

During year 16,476,769 c. y. removed from Culebra Cut. Amount remaining again increased over that reported a year ago by 3,595,000 c. y., in order to allow for slides already existing at the beginning of the fiscal year and for excavation along the upper levels of the banks of the canal, where slides had developed or were anticipated, and outside of prism lines. Total removed during year outside of slope lines and because of slides aggregated 5,915,000 c. y., or 35.90 per cent of total amount removed from cut as against 30.07 per cent during previous fiscal year. Total due to slides so far removed aggregates 16,671,000 c. y.

Work in cut retarded on account of slides and breaks in its banks which increased as cut was deepened. At the Cucaracha slide, practically at rest for over a year, the angle of repose is somewhat steeper than 1 on 5, while Culebra slide on west bank, where the material is still moving, present slope is about 1 on 5. In the slide on west bank just north of village of Culebra, moving material is of stratified rock moving in mass on layer of lignite which has an inclination of 1 on 7. This slide developed early in dry season. These very flat slopes of the bank in the deepest portions of the cut explain the large amount of material added by slides and breaks over original estimates. Relatively small slides developed as cut deepened, but the largest one now in motion is that which results from a break in west bank at Culebra, an area of about 63 acres. From this slide 2,710,000 c. y. removed during year, making total thus far taken out of 6,765,000 c. y. Next largest slide lies on east side of the cut, opposite Culebra, an area of 50.7 acres. From this slide 1,960,000 c. y. removed during the past year, making total of 4,290,000 c. y. taken out since 1907.

Work, begun Jan., 1911, of decreasing pressure on banks where breaks might be expected continued throughout year; 3 steam shovels kept continuously at work terracing west bank in vicinity of Culebra, and the same number during greater part of year on similar work on opposite bank.

Increases in estimates of material to be removed, made necessary by slides, will cause no increase in total estimated cost of Culebra Cut. None of the slides which occurred during the year would have interfered with the passage of ships had the canal been in operation.

Aug. 15, 1911, arrangements perfected for draining through the central culvert of the Pedro Miguel Locks. Dike separating cut on north side from Chagres River remained intact, and pumping plant previously described continued in service to handle water which drains to north from summit.

Diversion channel on east side of cut, for carrying Obispo River and tributaries, gave trouble during year. In Mar., 1912, cracks appeared to south of Empire suspension bridge, indicating motion of material lying between diversion and cut. Steps were taken to relocate this part of the diversion farther to the eastward. Excavation in Apr.; in all, 26,168 c. y. removed; new portion 1,970′ long and located 510′ east of old diversion at its most distant point. Empire-Paraiso wagon road and railroad reconstructed on west bank of new diversion. When water was turned into new channel weight of threatening bank lightened by removing material between old portion of diversion and face of cut. Slide on east side of canal, opposite Whitehouse, threatened to break into Obispo diversion at that point.

Movement of material slow, but it was deemed safer to relocate diversion about 100′ eastward of location, and work with this in view undertaken toward close of year.

Trains loaded in cut were hauled out at either end to dumps. Dumps used for wasting material from canal proper after Feb. 15, when service to Gatun was discontinued, were those at Miraflores and Balboa for trains run to south, and relocation dumps for trains run to north over Chagres River bridge. Material from high levels on both sides of canal wasted on local dumps, with exception that a few of Lidgerwood trains serving shovels at Rio Grande and Culebra were run over Panama R. R. to dumps at Miraflores and Balboa. For finishing work at San Pablo, 3 old dumps reopened and 2 new river dumps utilized. Tabernilla dumps reopened and used during Mar., 1912, for wasting material excavated at that point. Between Balboa Y and Ancon and Sosa Hills 72 acres of marshy land that could not be drained filled in, 1,022,591 c. y. from canal being used. Of spoil hauled from central division, 1,585,184 c. y. sent to Gatun for use on dam in back fill of locks; 2,872,950 c. y. wasted at Miraflores; 3,930,543 c. y. used at Balboa, partly in reclaiming swamp, partly in extending breakwater and the rest wasted; 5,268,890 c. y. dumped along relocation between Caimito and Gamboa.

In addition to amount wasted on central division dumps—15,259,391 c. y.—1,883,676 c. y. were furnished other divisions. Material previously wasted at Miraflores, Balboa, and on relocation dumps having settled firmly, found more economical to place new layer or form new dump on top of them than to start new ones.

Prior to June 30, 1911, the Naos Island trestle had been constructed for 2.78 miles. During year this trestle extended 1,360′, giving total length of trestle to June 30, 1912, of 16,051′, or 3.04 miles. The length of the trestle on June 30, 1912, was 1,320′ from Naos Island, and fill extended to within 2,000′ of its end, or 3,320′ from island. Total vertical settlement at one locality on the dike during the year aggregated 125′. Elevation of top of trestle 14′ above mean tide, and average depth of water for last mile of trestle constructed is about 15′ at mean tide, giving total height of trestle of about 29′ above original bottom. When rock is dumped from trestle it begins to settle as soon as it attains a height of a few feet, displacing adjacent material which, pushing up, forms parallel ridge of mud. By the time rock fill completed, these parallel ridges are about 80′ from center of track. To lessen difficulties and to spread foundations as much as possible, suitable material removed by dredges in channel dumped in front of trestle and spread on either side of center line. A board appointed to submit a plan for hastening progress on the construction of this breakwater recommended building double trestle, dumping on either side, thereby spreading fill and continuing fill to mean tide out to the island, thereby saving the trestle, which is to be made more substantial than formerly. When fill has been extended to island it is to be carried to full height, commencing at the island; should a break occur in the trestle, there would be considerable length of it left to fill over. This was approved, and double trestle built.

Empire machine shops continued making shop repairs and manufacturing repair parts for steam shovels until close of year, when they were transferred to mechanical division. Twenty steam shovels repaired in shops. Night repair gang continued for field repairs on shovels; average number repaired in the cut each night, 14.

Empire-Chorrera Road, commenced Apr., 1911, continued. On June 30, 1912, macadam had been laid and rolled on 11,230 lineal feet. In addition to this, subgrading, including necessary concrete culverts and drains, completed for 12,450 lineal feet. This is a 16′ macadam road and will extend from village of Empire to zone boundary, 6 miles; Panama Government has promised to extend it to Chorrera. Empire-Paraiso Road relocated for 2,480′ and reconstructed; made necessary by slide on the east bank. In village of Culebra 1,400′ of road reconstructed, on account of slides on west bank. In village of Golden Green 1,650′ of road constructed.

In Dec., 1911, realized necessary to install auxiliary pumps in Chagres to assist reservoirs in furnishing a sufficient amount of water for general use in the central division until such time as the rainy season should replenish supply. Purchase made of two 3-stage centrifugal pumps, belt driven, with rated capacity of 2,000,000 gallons under working pressure of 150 pounds; installed under Chagres River bridge; put into service Jan. 24, 1912, acting as feeders for mains on east and west banks of canal. During latter part of Feb., on account of draining off supply in Caraball Reservoir, Chagres River pumping station operated to supply water to Gorgona shops for mechanical purposes. On Mar. 12 a 6-inch line completed connecting Gorgona and Gamboa systems, supplying water to Panama R. R. tank at Matachin, town of Matachin, Jamaicatown, and engine house at Gorgona shops. On Apr. 18 additional piston pump installed on Sardanilla River, which increased supply for canal purposes at this point to 400,000 gallons per day. On June 8 piston pump, having capacity of 1,500 gallons per minute under a working pressure of 250 pounds, procured from Atlantic division and installed by the date supply in Camacho Reservoir was exhausted. An underwriters' fire pump procured from subsistence department also installed in Chagres River.

Sanitary work consisted of digging 5,763 lineal feet of ditches; regrading 311,061 lineal feet of ditches; cleaning 1,613,820 lineal feet of ditches; laying 550 lineal feet of tile drains; constructing 11,650 lineal feet of concrete gutters; cleaning 341,214 lineal feet of concrete drains; and clearing 6,536 sq. y. of brush and grass. **P-12**, 24–30.

1913. Excavation for prism during year confined to Culebra Cut, and 12,582,124 c. y. removed. In addition, 155,376 c. y. excavated in changing portions of Obispo diversion and 35,888 c. y. outside of canal prism for auxiliary work; total handled by central division, 12,773,388 c. y., of which 10,098,099 c. y. rock; 46.67 per cent removed from cut due to slides, against 35.90 per cent during previous year. Amount remaining to be removed again increased at close of year; an increase for central division of 9,280,237 c. y. over estimate in last report. Of this total remaining, 1,324,944 c. y. inside prism lines and 6,860,500 c. y. estimated for slides, which includes benching back of banks to relieve pressure which, crushing underlying strata, may either increase extent of slides or cause new ones. Total material due to slides so far removed, 22,570,200 c. y., or increase of 2,304,200 c. y. over estimate in last report.

Predictions of geologist with reference to Cucaracha slide, that "the end of the activity of this slide is now well in sight," have not been realized. Jan. 20 basalt rocks broke and there slid into cut approximately 2,000,000 c. y. Work continued on slide during year, for purpose of maintaining tracks on 67′ level open. Slide at close of fiscal year had area of 50 acres. Total removed since July, 1905, when it began moving, 3,859,500 c. y., leaving approximately 1,500,000 c. y. still to be removed. From West Culebra slide 1,922,700 c. y. removed; making total from Oct., 1907, of 8,687,600 c. y.; leaving approximately 2,390,000 c. y. Slide covers 68 acres. At East Culebra slide 1,676,300 c. y. removed; making total of 5,966,200 c. y. removed since Jan., 1907; estimated 2,000,000 c. y. remain; covers 55 acres and extends from north side of Gold Hill for 5,500′.

Break occurred Aug. 20, 1912, north of one previously reported at La Pita Point, which turned Obispo diversion into canal, flooding it and stopping steam-shovel work to north. Shovels removed, earth dam built across cut south of break to protect cut between it and summit, area then freed from water by pumps, and temporary channel constructed for diversion. After new channel had been excavated for Obispo diversion slide was attacked, and 181,100 c. y. removed.

On east side of cut, north of Gold Hill, there is a French dump included within East Culebra slide. Crack developed Apr. 1, 1913, parallel to cut and 635′ distant from its edge. Steps taken with steam shovels to bench this portion of bank and arrangements made for sluicing as much as possible into valley to east.

Summit of drainage in cut continued about opposite Culebra until two shovels cutting to grade on bottom produced one cut through at grade June 28, 1913. Water south of summit drained into Pacific through central culvert of Pedro Miguel Locks. Dike separating cut on north side from Chagres River remained intact and pumping plant previously described continued in service to handle water which drains to north from summit, with addition of two French centrifugal pumps, 17″ discharge, added after break north of La Pita Point.

With the opening in spillway at plus 50, with upper gates at Pedro Miguel not complete, feared heavy freshet might top dike at Gamboa and do injury to locks. Decided to raise Gamboa Dike to elevation 78.2, carrying this elevation along west dike which separates west diversion channel from cut. Material utilized for this purpose aggregated 37,080 c. y.

As cracks developed in sides of Obispo diversion, giving the appearance of additional slides which, if they occurred, would let water of diversion into cut, decided to relocate diversion farther to east; done opposite Whitehouse, opposite the division office at Empire, and around break north of La Pita Point. This necessitated handling 128,076 c. y.

Lirio drainage channel changed farther to the west, and in making change 27,300 c. y. handled.

All trains loaded in the cut were hauled out at either end to the dumps. On account of the grades that had developed due to deepening cut, it was necessary to use an average of 7 engines per day as pusher engines to get these trains out in carrying the loaded trains up the inclines at either end. With contracted area of operation, steam shovels placed closer together and necessitated an average of 6 locomotives daily to handle the trains to and from the shovels, besides those used in hauling the trains to the dumps.

Due to development of slides and beginning Feb. 20, 1913, split-shift system inaugurated on shovels working in slides and on upper benches, to secure 12 hours' work per day. This increased cost, but it was more than justified, after decision had been reached to admit water into the cut in Oct., in order to remove as much of remaining rock in dry as possible.

Dumps in use during year were those at Miraflores, Balboa, along line of railroad relocation north of Gamboa, swamp lands in the vicinity of Ancon, and a new dump opened along the line of the Panama R. R. south of Pedro Miguel. Necessary to abandon old line of Panama R. R. in the vicinity of Miraflores Locks to permit construction of spillway, and subsequent to Mar. 4 trains had to be operated over the single track through the tunnel. This reduced trains that could be operated to south and caused opening up of Pedro Miguel dump. Material taken from upper benches on east side of cut wasted partly in extending

dump north of Gold Hill started 2 years ago, and remainder dumped at Miraflores, Ancon, and Balboa, operating over Gold Hill cut-off of Panama R. R. That taken from upper benches on west side wasted on old dump at Culebra and on dumps to the south. 284,755 c. y. dumped on east side of cut. At Miraflores 1,288,262 c. y. wasted; 3,985,129 c. y. used reclaiming swamps at Balboa and wasted on Balboa dump; 440,725 c. y. used for filling swamp lands northeast of Ancon Hill; and 4,376,080 c. y. on Panama R. R. relocation dumps between Caimito and Gamboa. During year 90 acres filled in at Balboa, making a total of 474 acres in all reclaimed at this point. Between Balboa Y and Sosa Hill 54 acres marshy land filled during year. In addition, 487,108 c. y. waste furnished other divisions and the Panama R. R.

On June 30, 1913, Naos Island trestle entirely completed and filled, with exception of stretch about 600′ long. Total used, 653,242 c. y. Soft material was pushed out and up, forming a ridge of mud, intermixed with stones that had been dumped in and carried up by soft material, parallel to breakwater and 100′ from it.

Total removed from central division since American occupation up to close of year, 107,139,181 c. y., at average cost of $0.7105 per c. y. Of this, 93,305,975 c. y. removed from Culebra Cut.

Empire-Chorrera Road completed; convict labor employed on it transferred to other work, and small force of paid labor established for placing screenings and doing other work necessary for completion of road to zone boundary. On Nov. 27, 1912, 16′ macadam road from Gamboa to a point on Las Cascadas plantation road, about 3,600′ from east end of Empire suspension bridge, undertaken. Road will have a length of over 5 miles. Stockade erected at Gamboa to house prison labor engaged on it. Empire-Paraiso Road relocated and rebuilt for 5,608′, due to slides. In village of Culebra 2,370′ road reconstructed on account of slides. At Lirio camp 253′ of road constructed. For preservation of the roads and comfort of public oiling of highways during dry season authorized; treatment applied to 27,000 linear feet of road in villages of Empire and Culebra. Necessary to resurface 16,323 linear feet of Gorgona-Bas Obispo Road.

For maintenance of water supply to shops and for other construction purposes, additional pumps installed and operated at Lirio, Sardanilla River, Gamboa, and Gorgona shops.

Sanitary work consisted in digging 4,986 linear feet of ditches, regrading 602,578 linear feet of ditches, cleaning 1,327,676 linear feet of ditches, laying 6,426 linear feet of tile drains, constructing 3,852 linear feet of concrete gutters, cleaning 847,852 linear feet of concrete ditches, and cleaning 908,331 sq. y. of brush and grass. **P-13,** 23–28.

1914. With admission of water into Culebra Cut by blowing up of Gamboa Dike on Oct. 10, 1913, central division was abolished. Remaining dry excavation in the territory covered by this division was placed under a resident engineer reporting to the chief engineer; all surveying work and dredging were placed under the sixth division of the chief engineer's office, and the transportation forces, with those of the first, fifth, and fortification divisions, were concentrated under a superintendent of transportation and placed with the second division of the office of the chief engineer; the central division's property accountability was transferred to the quartermaster's department. **P-14,** 2.

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  Annual **Rs.** usually present: lists of tables relating to stamps, mail, letters and parcels, money orders, customs operations, distillation taxes, saloon licenses, rents, administration of estates, postal savings, police and prisons, arrests, convictions, crimes, prisoners, deaths, accidents, water consumption, schools, teachers, school gardens, revenues, expenditures, balances, courts, supreme court, circuit courts, district courts, legislation, ordinances, steamboat licenses, fires, population, etc.

1909. Organization: Consists of the executive branch, which includes the divisions of posts, customs and revenues, police and prisons, schools, fire protection, public works, and the office of the prosecuting attorney; and of the judicial branch, which includes the supreme, circuit, and district courts of the zone. The head of the department represents the Isthmian Canal Commission in its relations with the Republic of Panama and foreign representatives accredited to Panama.

Legislative acts, etc.: Congressional legislation for the zone includes the provision in the sundry civil act Mar. 4, 1909, in regard to the use of local revenues of the zone, and act Feb. 27, 1909, relative to the use, control, and ownership of lands in the zone. Executive order Nov. 7, 1908, makes changes in the provision respecting appeals from the judgment of the district court. Order of Aug. 14, 1908, amends the Penal Code of the zone by repealing the minimum limit of punishment for grand larceny. Order of Jan. 6, 1909, extends to the zone the provisions of the acts of Congress respecting the use of safety appliances on railroads. Subsequently modified by Executive order June 11, 1909. Isthmian Canal Commission, au. of Sec. of War, under the Executive order of Apr. 15, 1907, adopted amendments to the regulations governing the sale of liquor, the water regulations, and the regulations governing the collection of taxes; and enacted an ordinance requiring the muzzling of dogs.

Beyond-zone relations: Relations with Panama satisfactory, and with other countries. Among matters taken up with Panama were sanitary work in cities of Panama and Colon; removal of sand from Panaman territory; purchase of land at Porto Bello, and stationing there zone police; legislation prohibiting soliciting of labor on the Isthmus of Panama; enforcement of decree prohibiting soliciting of labor.

Posts, customs, and revenues, etc.: Sale of stamps, $74,241.87, an increase of 2.2 per cent over preceding year. Money orders exceeded those of last year by $480,064.48 in value; 167,664 registered letters and parcels sent. Postal facilities increased; 198 vessels entered Ancon; tonnage, 485,076; 195 cleared with 485,997 tonnage. At Cristobal 208 vessels with tonnage of 432,250 entered; 207 cleared with tonnage of 429,363. No fees. June 30, 1909, 2,103 leases for lots, land, etc. Rents, $26,969.88. Act Congress, Feb. 27, 1909, provides for leases of public lands in the zone for a period not to exceed 25 years. Act also provides for survey of land if desired; funds for survey not available, leases made as in former years. Triangulation for a general survey of the Isthmus started. $98,970.86 collected on account of general taxes and licenses; 50 estates settled.

Police and prisons: Force, June 30, 1909, 245 employees. Arrests of year, 6,275. (See Courts, below.) New stations opened at

several points. Annex to penitentiary completed; 117 convicts confined in penitentiary at close of year; convicts generally employed on road work; 3 men executed.

Schools: Reorganized and systematized; 12 schools for whites, 17 for colored. Enrollment Oct. 1, 1908, 622 whites and 1,073 colored. Two high schools; 1 at Culebra and 1 at Cristobal.

Fire protection: New volunteer companies organized; at close of year there were 19 volunteer companies with membership of 380; drilled twice a month by paid fire department. Alarm system extended; 92 fires—21 in Panama. Total loss from fires, $2,739.92; value endangered, $816,593.65.

Public works: On June 30, 1909, 1,292 water and sewer connections in Panama, and 87 applications pending. Rentals over $60,000. In Colon there were 464 connections, and 27 applications pending. Collections, as rental, over $60,000. In zone, June 30, 1909, 272 water and sewer connections. New public market built at Cristobal. Public markets at 8 places. Public slaughterhouses at Empire and Gorgona.

Prosecuting attorney: Information filed against 398 persons; 204 convicted.

Courts: Supreme court held 13 sessions. Confirmed decision of circuit court in 3 criminal cases; reversed 1 case; 8 civil cases filed; 5 decided. In the circuit courts, 398 filings in criminal cases; 204 convicted, and 55 acquitted. Cases against 114 were dismissed; 25 cases pending; 163 civil cases disposed of during year, and 122 were pending. In the district courts, 6,025 cases filed; 770 acquitted; 219 discharged; 5 pending. Civil cases filed against 749; 732 disposed of; 17 pending.

Zone funds: At the beginning of the fiscal year $242,694.73 on hand in the treasury; $393,734.41 collected. Expenditures, $412,102.86 for public improvements, schools, maintenance of administrative districts, and contingent expenses in the postal service. P-09, 26, 27, 28, 29.

1910. Important Executive orders promulgated prescribe penalties for murder in first and second degrees; penalizing recruitment of labor in the Canal Zone for service in foreign countries; defining powers and functions of counsel and chief attorney and prosecuting attorney, amending the existing provisions of law respecting the filing of informations and the execution of criminal process; providing for charging an equitable proportion of cost of sanitary improvements to property owners in the district in which sanitary improvements made; board of local inspectors for examination and licensing of masters, mates, engineers, and pilots of steam vessels navigating the waters of the Canal Zone. Executive secretary abolished by Sec. of War, May 24.

Matters taken up with Republic of Panama and adjusted are stationing of zone police at Nombre de Dios in Republic of Panama; adoption of sanitary regulations; amendment of agreement with Panama for maintenance and operation of Santo Tomas Hospital; maintenance of insane of Republic of Panama in Commission hospitals; verification of survey of Canal Zone boundaries; and enforcement of Executive decree of Panama prohibiting recruitment of labor in cities of Panama and Colon. Relations of Isthmian Canal Commission with Republic of Panama and with foreign representatives continue satisfactory.

Posts, customs, and revenues: The postage sales for the fiscal year amounted to $83,847.10, an increase of $9,519.70 over the preceding year. Convention was concluded Aug. 1, 1909, for direct exchange of postal money orders between Martinique, the French West Indies, and the Canal Zone. 237 vessels entered at Ancon, with total tonnage of 400,910, and 238 vessels cleared, with tonnage of 399,690. At Cristobal 235 vessels entered, with tonnage of 636,191, and 232 vessels cleared, with tonnage of 625,958. No duties or customs fees collected; 2,783 leases in force, 1,892 for building lots and 884 for agricultural lands, an increase of 686. Rents collected during year, $27,282.29, slight increase. Appropriation of $75,000 made by Congress for a general land survey of Canal Zone. On account of general taxes and licenses, $107,642.58 collected, an increase of more than $8,000; 38 estates were settled.

Police and prisons: On June 30, 1910, the police force consisted of 259 employees. Reorganization made Feb. 1, 1910; zone, for police purposes, divided into 4 districts. Arrests, 6,947, an increase of 672. Of those arrested 5,467 were subsequently convicted, 1,211 dismissed, 40 confined in insane asylum at Ancon, 22 turned over to military authorities, 14 fugitives from justice delivered to Panama Government, and 148 persons arrested, at Porto Bello, in the Republic of Panama, turned over to that Government for trial. On charge of murder, 18 arrests were made; 5 were convicted, 8 acquitted, 1 dismissed, 1 confined in the insane asylum, and 3 awaiting trial; 138 convicts confined in penitentiary at Culebra; kept at work on public roads, grading, etc.; 8 pardons granted during year and 2 sentences commuted.

Schools: 12 schools for white children and 15 for colored children maintained, and on Oct. 1, 1909, there was an enrollment of 745 and 1,067, respectively. School gardens maintained in connection with colored schools.

Fire protection: Paid fire company established at Gatun and fire-alarm system installed; 2 new volunteer companies organized at Gatun, and 1 volunteer company discontinued at Ancon. 19 volunteer companies, with membership of 324. 123 fires; 12 were in Panaman territory. Value of Government property involved, as reported by the fire chief, was $1,174,017.19; total loss, $2,796.04.

Public works: 201 sewer and water connections made in Panama, total on June 30 being 1,493, with 84 applications pending. Collections from water rents from private consumers for the first three-quarters of the year, $50,159.15; net amount of bills rendered for quarter ended June 30, 1910, $16,384. In Colon 84 connections made, total June 30 being 548, with 28 applications pending. Total collections of water rents from private consumers and from the Commission and the Panama R. R. Co. during the first three-quarters of the year, $56,477.45; net bills rendered for fourth quarter, $19,507.90. Extension of water, sewer, and paving systems in Panama and Colon authorized by Congress will require amendment of existing agreements with Panama for collections of water rents; new contracts will be submitted. 244 private sewer and water connections made in zone, total now being 516.

Prosecuting attorney: Attorney filed 251 informations against 313 persons; resulted in 205 convictions; also represented the U. S. in 71 criminal cases appealed to the circuit courts.

Courts: Supreme court held 19 sessions. Confirmed dicision of circuit court in 2 criminal cases, and reversed decision of that court in 1 criminal case. 3 civil cases pending at beginning of year, 13 filed, and 10 disposed of. In circuit courts 382 criminal cases filed; 249 convictions secured and 39 acquitted; 68 cases dismissed, and 26 cases pending. Of 397 civil cases filed during year, 301 were disposed of and 96 were pending at close of year. In district courts, 6,732 criminal cases filed; 5,215 convictions secured and 812 acquitted; 366 cases appealed, and 9 cases pending. 1,123 civil cases filed, 1,055 disposed of, and 68 pending at close of year. **P-10, 41-44.**

1911. Only congressional legislation affecting zone during the year, other than change in employer's liability act noted, was act approved June 25, 1910—"To further regulate interstate and foreign commerce by prohibiting transportation therein for immoral purposes of women and girls, and for other purposes."

15 Executive orders having effect of law issued. More important of these to establish rules and regulations to facilitate and protect canal work; prescribing the jurisdiction of Canal Zone courts in civil cases where both defendant and plaintiff are nonresidents of the Canal Zone; respecting the conveyance of real estate by married women; providing a method of executing and recording deeds; respecting the arrest and discharge of deserting seamen; collection of distillation tax in the Canal Zone.

8 ordinances enacted by Isthmian Canal Commission relating principally to licensing automobiles, chauffeurs, and bicycles; rates for coach hire; keeping the watersheds free from contamination.

Of matters taken up with Republic of Panama and satisfactorily adjusted are modification of agreement by which Panama permitted to increase import taxes on certain articles from 10 to 15 per cent; charging of consular fees by consuls of Panama for certification of documents covering shipments consigned to Isthmian Canal Commission and Panama R. R. Co.; withdrawal from entry by Panama of lands situated in Republic which will ultimately be covered by waters of Gatun Lake; conveyance in certain cases of American citizens in city of Panama in need of medical attention to Ancon Hospital for treatment; fire protection in Panama and Colon; construction of roads in zone and continuation thereof in Republic; enforcement of laws prohibiting recruiting of labor on Isthmus; uniform coach rates for zone and Panama and Colon; uniform laws providing for collection of distillation taxes in the Republic and in Canal Zone; public improvements in Panama and Colon; suppression of white-slave traffic through Panaman ports and in Panama and Colon; revision of contracts between Republic and Isthmian Canal Commission for amortization of cost of waterworks, sewer system, and paving in cities of Panama and Colon. Relations of Isthmian Canal Commission with the Republic of Panama and foreign representatives satisfactory.

Steamboat-inspection service: Local inspectors issued 56 licenses to pilots; 7 to masters, 4 of which issued as joint master-pilot licenses; 12 to mates; and 11 to engineers. Rules for navigation of canal and all waters under Isthmian Canal Commission drafted and approved. Duties of board extended to include the general inspection of all floating plant of Isthmian Canal Commission and Panama R. R. Board also to examine and license chauffeurs of automobiles.

Posts, customs, and revenues: Postage sales, $82,893.72; a decrease of $953.38. There were in the post offices of zone on June 30, 1911, unpaid money orders aggregating $332,141.60 drawn to order of remitter and payable at office of issue, indicating extent to which post offices are used as depositories. Convention for direct exchange of money orders between zone and Costa Rica concluded Apr. 1, 1911. Effective Jan. 9, 1911, post office established at Toro Point. Agreement entered into between the postal systems of zone and U. S. for reciprocal payment of indemnity. Postal service also authorized to pay indemnity of 50 francs for loss of registered articles between zone and Postal Union. 264 vessels entered Ancon, with tonnage of 457,746; and 263 vessels cleared, with tonnage of 454,572. At Cristobal 263 vessels entered with tonnage of 722,870, and 264 vessels cleared with tonnage of 727,955. No duties, tolls, or customs fees collected, 2,251 leases in force, of which 984 were building lots and 1,261 for agricultural lands, a decrease of 530, due largely to cancellation of leases in Miraflores and Gatun Lake areas. Leases for agricultural lands covered 3,534 acres. Rents collected amounted to $23,469.22 $123,876 collected on account of general taxes and licenses. Of this, $2,353.88 for distillation taxes, $68,400 for licenses for sale of liquor, $512.59 for license fees from insurance companies doing business in zone, and $1,057 for 38 licenses for motor vehicles in zone.

Police and prisons: Force consisted on June 30, 1911, of a chief and assistant chief, 5 clerks, 2 inspectors, 4 lieutenants, 8 sergeants, 20 corporals, 117 first-class white police officers, and 116 colored officers. Arrests during year, 5,959, of which 5,500 males and 459 females; 80 per cent convicted. 148 convicts confined in penitentiary at Culebra. Prisoners used in public improvements wherever practicable, especially on road and street maintenance. Deportations of undesirable characters from Canal Zone, 111 persons; 2 pardons granted and 3 sentences commuted.

Fire protection: Organization consists of 1 chief, 1 assistant chief, 1 clerk, 1 messenger, 7 captains, 7 lieutenants, 41 firemen, 1 engineer, 1 electrician, and 1 lineman, constituting the paid fire force. Two volunteer companies disbanded. New volunteer company organized at Toro Point. Fire station opened at Mount Hope. At Gatun, one-story building constructed to provide quarters for paid firemen. New site selected for station at Cristobal. Station at Culebra moved to new site on account of slides. 252 alarms of fire responded to during year, 14 of which false; 1 in Panama and 8 in Colon; 147 in U. S. property and 36 in property of Panama R. R. Co. Value of U. S. and Panama R. R. property involved, $2,162,938.31. Total loss estimated at $17,433.42 for U. S. property and $5,123.07 for property of Panama R R. Co. Largest fire in Colon on Mar. 23, 1911; loss to the Isthmian Canal Commission, $14,394.93.

Public works: Organization consists of 1 superintendent, 1 assistant superintendent, 6 clerks, 1 inspector and messenger, 2 inspectors of plumbing, 1 inspector of meters, 1 market inspector, 3 engineers, 6 foremen, 11 masons, 12 pipefitters, 10 laborers, and 1 carpenter. In Panama 1,809 connections made with water mains and sewers and 42 applications pending. Water rents, total for year, $78,606.45. The Republic required to pay $4,316.06 in order to liquidate proportionate part cost of water, sewer, and street systems for year. In Colon 559 connections made and 64 applications pending. Collections in Colon, $76,433.10. Republic required to pay $2,748.83 to liquidate proportionate part of capital cost of water, sewer, and street systems due for year. On Sept. 30, 1910, new agreements or contracts entered into with Panama providing for quarterly adjustment of all payments due by Republic under plan of amortization of cost of water, sewer, and street systems in the two cities. Under new agreements total amount due from Republic to U. S. is taken as capital cost at that time. One-fourth of capital cost due at close of each quarter is taken as installment of such capital cost to be paid as of that date, and added thereto is interest on the capital cost for the quarter, together with the quarter's charges for maintenance and operation. Applied to the payment of these items is the total amount collected on account of water rents during the quarter. If a difference remains in favor of the U. S., Republic pays it; but if difference is in favor of the Republic, the amount is credited to capital cost due. In the zone 615 connections made. From 9 public markets in operation revenue of $4,796.67 derived.

Schools: Organization consists of 1 superintendent, 2 clerks, 1 supervisor of upper grades, 1 supervisor of primary grades, 2 supervisors of children, 1 principal of high school, 5 principals of grammar schools, 61 teachers, and 1 gardener temporarily employed. Oct. 1, 1910, there was an enrollment of 1,837 children; 931 in the white and 906 in colored schools. Highest monthly enrollment was in June, when 1,410 pupils enrolled in white schools and 1,568 in colored schools. Schools at Colon Beach, Las Cascadas, and Corozal consolidated with those at Cristobal, Empire, and Ancon, respectively. Pupils carried to and from schools either over Panama R. R. or by system of brakes or carryalls. Schools in operation throughout the year, 10 for white children and 15 for colored children. Additional white and 2 additional colored schools in operation for part of year. Zone high school transferred from Cristobal to Gatun, and branch high school established at Ancon. June 30, 1911, 11 schools for white children and 16 for colored children.

Courts: Supreme court held 16 sessions. It affirmed decision of circuit court in 3 criminal cases and reversed decision in 2 criminal cases. At beginning of year 6 civil cases pending, 9 filed, and 11 disposed of. In circuit courts 374 criminal cases filed; 234 convictions secured and 78 acquittals; 43 cases dismissed, and 19 cases pending at close of year; 339 civil cases filed during year, 231 disposed of, and 108 pending. In district courts 5,862 criminal cases filed, 4,464 convictions secured, 847 acquittals, 243 cases dismissed, 304 appealed to circuit courts, and 4 cases pending; 948 civil cases filed, 918 disposed of, and 30 pending. **P-11,** 48–54.

1912. Five ordinances enacted for night-quarantine inspection of vessels at port of Colon; market regulations for zone, and reciprocal license tax upon motor vehicles licensed in zone and in the Republic. Negotiations with Republic included the following: Fees by Panama consuls in San Francisco for certification of manifests covering shipments designed for port of Ancon; laws and regulations by Republic governing navigation of waters under its jurisdiction uniform with those of zone; occupancy of public lands of Republic by persons forced to vacate lands in Gatun Lake area; exercise of zone jurisdiction over Gatun Lake areas lying within territory of Republic; operation of Chinese-exclusion law in Republic and zone; adjustment of automobile license taxes; interference with U. S. mails in Colon; transfer by Panama R. R. Co. to Republic of certain lots in exchange for land situated opposite Hotel Tivoli; operation of schools for Panaman children by Republic within zone; extradition to U. S. of persons charged with carrying on white-slave traffic; extradition from zone to Panama of persons charged with crime; deportation of gamblers and other undesirable characters living in Panama and Colon; operation of saloons in Colon near zone line; enforcement of laws of Republic prohibiting recruiting of laborers; attempted exercise of police authority on zone territory by police officers of Republic; administration of estates of citizens of Panama who die in zone; marriages in Republic by Protestant ministers; customs inspection of baggage at Panama City R. R. station by Republic; repatriation of alien patients in Ancon Insane Asylum at expense of Republic; construction of buildings, streets, sewers, and other improvements; and maintenance of proper water service in Colon and Panama. Relations of Isthmian Canal Commission with Republic and with foreign representatives satisfactory.

In last report recommendation made for depopulation of zone. June 23, 1908, population was 50,003, but the accuracy of this questioned; thought advisable to take a new census. Census, taken as of Feb. 1, 1912, resulted in the following: Zone population (including the territory of the Canal Zone, the Commission settlements at Porto Bello and Nombre de Dios, Colon Beach and Taboga Sanitarium), 62,810. Employees of the Isthmian Canal Commission, Panama R. R. Co., and various canal contractors numbered, as of Feb. 1, 1912, 42,174. Of the 62,810 persons enumerated in zone, 1,521 Colombians and 7,363 Panamans; of total 9,157, 4,870 males.

Local inspectors issued 34 licenses to pilots; 9 to masters, 4 of which were issued as joint master-pilot licenses; 10 to mates; and 11 to engineers—a total of 64. 15 certificates of seaworthiness to launches. Licenses issued to 97 chauffeurs. Postage sales for year, $87,694.41; increase of $4,800.69 over previous year.

Postal-savings system established Feb. 1, 1912. At close of year on deposit in postal-savings banks, $356,947. Unpaid money orders aggregated $332,141.60.

327 vessels entered Ancon, with total tonnage of 619,422; same number of vessels cleared, with tonnage of 622,023. At Cristobal 284 vessels entered, with tonnage of 784,156; and 282 vessels cleared, with tonnage of 775,445.

In force, 858 leases, of which 575 for building lots and 258 for agricultural lands; a decrease of 1,383. Rents collected, $16,033.54. $122,674.54 collected from general taxes and licenses. 60 estates were settled.

7,055 arrests; 6,452 males and 603 females. 79 per cent convicted. 141 convicts confined in penitentiary at Culebra. Stockade erected on Mandingo River for temporary housing of convicts building Empire-Chorrera Road. Slides made necessary demolition of penitentiary buildings at Culebra.

In division of fire protection a discharge of 1 fireman and employment of a motor engineer. Concrete fire station at Cristobal completed. Small station at Balboa removed. Tivoli station altered to accommodate 1 of the 2 new combination automobile fire engines and hose wagons purchased during year. 333 alarms of fire, 18 of which were false; 6 were in Panama and 2 in Colon; 196 were in U. S. property and 21 in property of Panama R. R. Co. Value of U. S. and railroad property involved, $1,755,685.58. Total loss, $4,538.58 for U. S. property and $101 for property of Panama R. R. Co. Largest fire on zone totally destroyed 2 private frame dwellings at Miraflores and caused loss of $5,000. Year's fires resulted in 12 injuries from burns; 2 deaths occurred, 1 from explosion of gasoline fumes and 1 from explosion of alcohol.

In Panama 1,985 water connections made to date, and 35 applications pending. Water rents from private consumers for the first three-quarters of year in Panama, $67,491.75; and bills rendered for last quarter aggregated $25,436.25. For the second and third quarters of fiscal year water collection exceeded requirements by $4,293.26, which amount was placed in the amortization fund to be applied to reduction of cost of waterworks, sewers, and pavements. In Colon 731 connections made with water mains, and 45 applications pending. Collections in Colon, first three-quarters, $58,631.20; net bills rendered for fourth quarter, $20,623.80. Republic paid $10,943.11 to liquidate proportionate part of cost of water, sewer, and street systems. In zone 691 water connections. From 8 public markets a revenue of $4,183.95 derived. School year opened Oct. 1, 1911, with enrollment of 2,105 children—1,174 whites and 931 blacks. On June 30, 1912, 26 buildings used—11 for white schools and 15 for colored schools. Medical inspection of pupils, inaugurated during preceding year, continued. Supreme court held 12 sessions. Affirmed decisions of circuit court in 4 criminal cases and reversed ruling of that court in 1 criminal case; 4 civil cases pending in supreme court, 6 were filed, and 8 disposed of. In circuit courts 567 criminal cases instituted; 353 convictions, 126 acquittals, and 84 dismissals, leaving 23 cases pending. 541 civil cases filed during year; 414 disposed of, 127 pending. In the district courts 7,128 criminal cases instituted; 5,183 convictions secured, 1,063 acquittals, 350 dismissals, 528 appeals to circuit courts, leaving 4 cases pending. 1,305 civil actions brought; 1,280 disposed of and 25 pending. **P-12,** 58–62.

1913. Seven acts of Congress and 4 joint resolutions affecting the Panama Canal and zone enacted, most important being Panama Canal act, approved Aug. 24, 1912, providing for opening, maintenance, protection, and operation of canal and sanitation and government of zone. Four ordinances enacted, most important of which amended certain rules governing navigation of canal and approaches. Resolution adopted that no further licenses be granted for sale of intoxicating liquors in zone.

Negotiations carried on with Republic include following: Arrest by Panaman police of Isthmian Canal Commission employees while engaged in performance of duties in Colon and Panama; reciprocal licensing of carts and wagons used in transportation of merchandise in Republic and zone; municipal and sanitary improvements in Colon and Panama; superior right of U. S. under treaty to use rivers and streams of Republic; deportation to Republic of ex-convicts who have served terms of imprisonment in zone; admission of merchandise shipments consigned to Isthmian Canal Commission, Marine Corps, Tenth Infantry, and wireless stations, without intervention of Panaman customs officials; delay in customs release covering shipments consigned to Isthmian Canal Commission and Panama R. R. employees; collection of customs duties on parcel-post packages coming through post offices of zone; establishment of uniform schedule of rates to be charged for transporting passengers by automobile between points in zone and Colon and Panama; collection of tax by Panama upon steamship tickets covering passage to foreign ports; and tax upon steamship agencies doing business in zone and Republic. Relations with Republic and with foreign representatives satisfactory.

Local inspectors issue 88 licenses to pilots; 41 to masters, 19 of which issued as joint master-pilot licenses; 22 to mates; and 58 to engineers—total of 209 licenses. Certificates issued to 94 vessels, of which 18 were over 100 gross tons burden. 162 licenses as navigators of motor boats granted. Licenses issued to 120 chauffeurs.

Postage sales for fiscal year, $100,804.38; an increase of $13,109.97 over previous year. At close of year there was on deposit in postal savings banks $645,690. There were unpaid money orders aggregating $156,928.

281 vessels entered Ancon, with tonnage of 553,767; and 283 vessels cleared, with tonnage of 556,306. At Cristobal 280 vessels entered, with tonnage of 849,702; and 283 vessels cleared, with tonnage of 858,703.

319 leases, of which 312 were for building lots, 1 for land, and 6 for buildings. Rents amounted to $4,792.95. $53,855.95 collected from general taxes and licenses. 470 estates were settled.

Reorganization of police and prisons on Sept. 1, 1912; strength of force reduced from 274 to 247. 6,827 arrests; 6,079 males and 748 females; 77 per cent convicted. 133 convicts in penitentiary. Stockade on Mandingo River closed during the year and all convicts transferred to new stockade.

In division of fire protection there was actually a reduction of 15 men as compared with the number in service at close of previous year; made necessary by a cut in appropriations. 2 automobile fire engines, made possible discontinuance of 1-man stations at Balboa and Mount Hope, consolidation of 2 Ancon stations, and sale of 6 fire horses. Equipment in buildings at Gorgona removed upon abandonment of that settlement and most of it installed in buildings reconstructed at Corozal and Balboa. 220 alarms of fire; 18 false; 1 was in Panama and 7 in Colon; 104 were in U. S. property and 20 in property of Panama R. R. Co. Value of U. S. and Panama R. R. property involved, $834,077.44; loss estimated at $12,173.77 for U. S. property and $501.75 for property of Panama R. R. Co. Largest and most serious fire in zone at Toro Point, causing loss to Isthmian Canal Commission of $11,326.98. 5 injuries from burns.

All municipal improvements in Panama undertaken under appropriation of $80,000 which were completed turned over to this division for maintenance. On June 30, 1913, 2,101 water connections had been made in city of Panama; 22 applications pending. Water rents from private consumers for the first 3 quarters of the year in the city of Panama, $81,727.75, and bills for last quarter aggregated $32,583.75. For first 3 quarters of year collections exceeded requirements by $13,219.69, which was applied to reduction of cost of waterworks, sewers, and pavements. In Colon 866 connections had been made with water mains; 55 applications pending. Collections in Colon for first 3 quarters, $64,058.15; net bills for fourth quarter, $24,168.80. For Colon, Republic paid $9,675.05 to liquidate proportionate share of cost of water, sewer, and street systems for first 3 quarters of year. In zone 695 water connections made. From 8 public markets $3,805.50 derived in rent.

Division of schools consisted of 1 superintendent, 1 supervisor of upper grades and high schools, 1 supervisor of primary grades, 2 clerks, 2 supervisors of children, 1 principal of high school, 6 principals of grammar schools, and 72 teachers. School year opened Oct. 1, 1912, with 2,199 children—1,157 whites and 1,042 blacks. At close of year 29 school buildings in use; 14 for whites and 15 for blacks. Medical inspection continued and 1,044 pupils treated.

Supreme court held 26 sessions; affirmed decisions of the circuit courts in 2 and reversed decisions in 2 criminal cases. 2 civil cases pending in supreme court, 22 filed, and 18 disposed of. In circuit courts, 533 criminal cases instituted, out of which 369 convictions, 93 acquittals, and 67 dismissals, leaving 4

cases pending. 858 civil actions brought, 750 settled, and 108 pending. **P-13,** 61–65.
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Surveys of construction of outer harbor, direct entrance to canal, inner harbor, and completion of Gatun diversion. Bids invited for widening and deepening Colon end of the canal for reception of construction material. Bids too high. **P-05,** 12.

Town on a swamp. Difficult to sanitate. Temporary measures taken until line of canal terminus is fixed. **P-05,** 43.

1910. Colon and Panama: Municipal improvements originally undertaken in cities of Colon and Panama restricted to certain portions of the towns. Extension of Colon eastward of improved section prevented by sanitary regulations; additional area for building purposes considered necessary and advisable. Certain districts in Panama built up without extension of paving and of sewer and water mains, and Isthmian Canal Commission in 1908 submitted to Congress an estimate of $1,200,000 for extending municipal improvements in the two cities. Act Mar. 4, 1909, making appropriations for canal included an item of $800,000 for extending improvements, and arrangements made for undertaking work during dry season of 1909–10. Amount thus appropriated will be added to that already expended in two cities and refunded at end of the 50-year period from collection of water rents.

Colon: Work in Colon consists of construction of D Street storm sewer. At close of year work about half finished; 6,473 c. y. excavated, 1,628 c. y. concrete laid, and 1,081 c. y. of back fill made.

Panama: Streets graded and macadamized, and sewers, water mains, and concrete curbs and gutters placed as follows:

	Paving.	Curbing.	Sewer mains.
	Sq. ft.	*Lin. ft.*	*Lin. ft.*
Cocoa Grove district	70,130	3,920	1,683
Guachapali district	195,354	8,171	7,535
Avenue B	36,607	2,220	1,937
Santa Cruz district	91,116	5,062	8,078
District I	24,240	1,275	1,496

	Sewer laterals.	Water mains.	Water laterals.
	Lin. ft.	*Lin. ft.*	*Lin. ft.*
Cocoa Grove district	872	2,494	1,185
Guachapali district	1,952	8,289	4,012
Avenue B	665	1,847	788
Santa Cruz district	1,952	7,692	4,058
District I	628	1,195	677

P-10, 29–30.

1911. Colon: During year the D Street storm sewer, extending from the sea at Beach Road on the north to Folks River on the south, with outlets at either end and with the summit elevation at Eighth Street, practically completed; 12,881 c. y. excavated; 5,000 c. y. concrete installed; and 7,235 c. y. back fill placed. Fill started Oct. 31 with 20″ suction dredge and continued throughout year; 501,786 c. y. made. Drainage system south of Ninth Street completed. Paving on D Street completed, except half a block. Sections south of Ninth Street covered with rock. Rock to extent of 10,918 c. y. used in street paving. 23,800′ curb and gutter placed.

Panama: Of amount appropriated by Congress, $250,000 allotted for improvements in city of Panama, included within districts of Guachapali, Santa Cruz, Cocoa Grove, Avenue B, and District I. Work consisted of grading and macadamizing streets, laying concrete curbs and gutters, together with sewers and water mains. Work completed. In addition, La Neveria graded and paved, and intercepting sewer laid to prevent flooding of Central Avenue and adjacent property. Survey and plans made for developing district bounded by Zone Line Road, B Street, Fourth of July Avenue, and West Sixteenth Street. **P-11,** 27–29.

1912. Colon: Work continued during fiscal year, suction dredge continuing operations until Aug., 1911, when it had added 129,939 c. y. to that laid during the previous year. Total fill actually placed, 585,527 c. y. Fill was for lots as well as streets, the former paid by property owners. In addition to fill, 9,826 linear feet water mains and 9,603 linear feet sewer lines laid, 3,931 sq. y. macadam added in surfacing D Street, 40,794 sq. y. macadam laid in improved areas, including 1,560 sq. y. of resurfacing on other streets, 21,440 linear feet of curb and gutter built, 1,590 sq. y. concrete alleys, and 1,341 sq. y. sidewalk constructed. 2,015 linear feet curb and gutter replaced.

Panama: Panama unable to pay for some improvements proposed last year, and as improvements were required for sanitary purposes, and as there was an unexpended balance of the amount allotted for work in Panama, authority given to make improvements; work performed comprised grading and macadamizing streets, placing concrete curbs and gutters, and laying water mains and sewers in portions of city. **P-12,** 38–39.

Colon Division. (See No. 134, p. 2364 of this Index.)

Colon division: Covers all works of technical engineering and construction pertaining to the canal from Bohio to the Caribbean Sea. During period of the report, made surveys, borings, did dredging, repair and construction of floating equipment, and a lot of track work; the latter transferred later to the Panama R. R. Supervision of wharf and dock work for a time in this division. An old French ladder dredge kept continuously at work dredging channel at mouth of canal. Contracts made for 2 modern dipper dredges—1 for La Boca and 1 for Colon—

both ports being kept open by 2 old French dredges which had been repaired. Work on this division has been delayed owing to lack of material of all kinds. **P-05,** 114.

Division divided into 2 sections—Cristobal section, from sea to Mindi, and Gatun section, Mindi to Bohio. Miscellaneous surveys, borings, plans for dredges, fitting up of shops, repair of plant, installation of new floating plant units, etc., representative of work of the year. 866,500 c. y. dredged from Colon Harbor. **P-06,** 82.

(See Atlantic division and Central division.)

Color.

Deaths by. (See Health.)

Comber, W. G. (See Nos. 256, 264, p. 2368 of this Index.)

Commerce.

U. S. occupation of zone beneficial to local interests, **P-05,** 53.

Usefulness of terminal plants to, **P-14,** 187.

Commerce, Special Report on Probable. (See Nos. 9 and 24, p. 2361 of this Index.)

Advantages of canal at Isthmus twofold—industrial and commercial. Canal would assist wide range of industries in every section of the U. S.; would remove restrictions in obtaining cheaper raw material; and would increase ability of the U. S. to compete with other nations for world trade. Pacific coast industries would benefit also, especially through a probable reduction in freight rates. **P-99,** 161.

Domestic coal traffic would be increased. There would be notable favorable effects upon eastern and southern parts of the U. S. Railroads connecting the Mississippi Valley with Pacific ports would probably feel canal competition most. Sailing craft would continue giving way before steam craft, but they would not be eliminated. Isthmian Canal expected to produce large results in developing industries and commerce of Pacific Ocean countries. New route would give U. S. a decided advantage over other nations in this trade. Canal at Isthmus would probably place U. S. on equality, in distance, with Europe, in trade with the Orient and Australasia. **P-99,** 162–163.

Probable cargo tonnage which would choose canal route at 1899 (were canal existing), over 6,702,541, **P-99,** 163.

Expected that increase of about 25 per cent a decade would raise traffic of 5,000,000 in 1899 to 7,000,000 tons in 1914, and that a growth of about 62 per cent during the succeeding 10 years would make a tonnage of 11,375,000 in 1924, **P-99,** 164.

Traffic through canal would depend in part on tolls. In fixing these, the principal of maximum revenue could not wisely be followed. Revenue subordinate to promotion of industrial and commercial aspect of U. S. progress. Annual traffic of 7,000,000 tons at 1914, at $1 a ton, equals revenue of $7,000,000. As cost of operating and maintaining of Panama route estimated at about $2,000,000 per annum; of Nicaragua route, about $3,300,000; revenue annually at $1 per ton would not permit a return on the capital invested. Annual traffic would increase steadily. Rates on Suez Canal about $2 a ton; not probable that Suez Canal would find it profitable to reduce its tolls to compete with an Isthmian Canal. It might be expedient to reduce tolls on an Isthmian Canal to cover only the cost of operating and maintenance. **P-99,** 164, 165.

Relative commercial advantages of Nicaragua and Panama routes: Distance for American commerce generally would be less by Nicaragua route. From Europe to western South America, distance less by Panama. From Europe to North Pacific, Nicaragua route shorter, 12 hours required for passage through Panama route; 33 hours through Nicaragua route; which would slightly offset the nearness of the two opposite coasts of U. S. through Nicaragua. Latter route better for sailing ships (not an important factor). **P-99,** 165, 166.

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	Nicaragua.	Panama.
From New York to—		
San Francisco	4,921	5,299
Yokohama	9,457	9,835
Hongkong	11,366	11,744
Sydney via Tahiti	9,676	9,852
Wellington via Tahiti	8,716	8,892
Iquique	4,393	4,021
From New Orleans to—		
San Francisco	4,118	4,698
Yokohama	8,654	9,234
Hongkong	10,563	11,143
Sydney via Tahiti	8,873	9,251
Wellington via Tahiti	7,913	8,291
Iquique	3,590	3,420
From Liverpool to—		
San Francisco	7,651	8,038
Yokohama	12,187	12,574
Hongkong	14,096	14,483
Sydney via Tahiti	12,406	12,591
Wellington via Tahiti	11,446	11,631
Iquique	7,123	6,670

P-99, 627.

Tonnage at 1898–1899 which might use an Isthmian Canal, **P-99**, 628. Difficulty of obtaining full or complete statistical data concerning traffic tonnage at ports, etc., **P-99**, 628. Method pursued in constructing data groups or tables, **P-99**, 629. Discussion of the average values of the cargo ton, **P-99**, 637. Tonnage of the commerce between Europe and the west coast of South and Central America and British Columbia and Hawaii, **P-99**, 638. Diagram of tonnage, 1888 and 1895–1899, sailing vessels, and steamships, **P-99**, 640.

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Traffic investigations made by the New Panama Canal Co., and comparison of the results of three different investigations relating to traffic probabilities by way of an Isthmian Canal, **P-99**, 650.

The New Panama Canal Co. divided that part of the world's commerce capable of being affected by an Isthmian Canal into the four groups adopted, 1890, by the Commission d'Etudes appointed by the receiver of the Compagnie Universelle du Canal Interoceanique: (1) Between Europe and the Pacific coast of the American Continent; (2) between Europe and the Far East; (3) between the Atlantic and Pacific coasts of America; and (4) between the Atlantic coast of America and the eastern countries of group 2, **P-99**, 650.

Concerning use of American canal by commerce of Europe with Orient, shipping may go by Suez and return via Panama, etc., **P-99**, 652. Evidence of increasing number of round-the-world voyages, **P-99**, 653. Tonnage of available canal traffic, **P-99**, 654. Growth of traffic, 1888-1898, **P-99**, 654. Rapidity and extent of substitution of steamships for sailing vessels, **P-99**, 655.

The three different investigations to measure the probable value of an Isthmian Canal confirmatory of each, although made without reference to each other. Two were made by Isthmian Canal Commission, and one under direction of New Panama Canal Co. **P-99**, 657.

Probable growth of canal traffic, 1899-1914, and 1914-1924, **P-99**, 658. Rate of increase shown by tables of the Panama Canal Co., **P-99**, 658. Increase in trade between Europe and western coast of America, **P-99**, 659. Growth in trans-Pacific trade of the west coast of the U. S., **P-99**, 659. Probable available canal traffic, 1914, **P-99**, 660. Estimate of growth of traffic during the first decade of the use of the canal, **P-99**, 661. Table showing graphically the growth in the tonnage using the Suez Canal, 1870-1899, **P-99**, 662. Estimate of growth for 1924, **P-99**, 662.

Tolls, **P-99**, 664. Tolls charged on Suez Canal, **P-99**, 664. Table showing number and size of vessels, with receipts from tolls, Suez Canal, **P-99**, 665. Table showing increase in number and size of vessels, and receipts, Suez Canal, quinquennial periods, 1875-1899, **P-99**, 665. Effect of tolls on volume of traffic of Suez Canal, **P-99**, 667. Tolls of an Isthmian Canal, and Chilean traffic, **P-99**, 667. Isthmian tolls, and Australian trade, **P-99**, 669. Tolls of Isthmian Canal, and Philippine trade, **P-99**, 670. "In the foregoing discussion a toll of $1 a ton (net) has been made the basis of reasoning because that represents a maximum beyond which the charge ought not to go. A tariff much higher than that would in all probability so restrict the tonnage passing the canal as to reduce the revenue derived from the tolls. Such a restriction would unfortunately limit the industrial and commercial value of the canal. The lower the tolls, the greater the traffic of the canal and the larger the industrial and commercial benefits. It is believed that a toll of $1 a vessel ton net register would yield an income sufficient to pay the expenses of operation and maintenance and a moderate return on the capital invested. Should the U. S. prefer to levy tolls sufficient only to cover the cost of operation and maintenance, a tariff of one-third of a dollar a ton would probably suffice." **P-99**, 671.

Plates relative to commercial data: World routes for steam and sail, **P-99**, pl. 74, 75. Resources and industries of Chile, **P-99**, pl. 76. Resources and industries, northwest South America, **P-99**, pl. 78. Resources and industries, Japan, **P-99**, pl. 79. Resources and industries, China, **P-99**, pl. 80. Resources and industries, East Australia, **P-99**, pl. 81. Resources and industries, New Zealand, Philippine Islands, Central America, Mexico, **P-99**, pl. 82-85. Map of Transportation Divides, **P-99**, pl. 86.

Commissary. (See No. 94, p. 2363 of this Index.)
Interior, **P-11**, 384, pl. 74.

Local source of supplies of no value. 17,000 men to feed. Local commissary stores opened. Panama R. R. steamers equipped with refrigerating plants, etc. Refrigerator cars purchased. Line of refrigeration established from the markets of the U. S. to the commissary stations of the Isthmus. Management of local hotels assumed by Isthmian Canal Commission. Laborers fed for 30 cents per day; gold employees for 90 cents per day. **P-05**, 8.

Cost of living not as great as supposed. Adequate food for West Indian laborers a problem; their efficiency affected by lack of proper nourishment. Commissary established. Refrigerator service line from U. S. established. Hotels and boarding camps maintained and operated by the Isthmian Canal Commission No. 3. **P-05**, 46.

Commissaries opened for silver employees (tropical denizens); objection of local merchants; full publicity given to reasons by Isthmian Canal Commission; opinion of zonal inhabitants favorable to action of the Isthmian Canal Commission; coupons issued to employees; acceptable by merchants; probable restriction of commissary to actual necessities of the silver employees, **P-05**, 48.

Commissary stations, hotels, and eating houses under auspices of the Isthmian Canal Commission effective in producing more satisfaction among employees, **P-05**, 123.

Fourteen hotels and mess houses for white employees. Profit of $5,000 for period ending June 30, 1906, as opposed to a former deficit. **P-06**, 3.

(See No. 224, p. 2366 of this Index.)

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  Directing commission, canal work, organization proposed, **P-04,** 13.
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  Machinery, installation of, **P-13,** 98.
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  Mixing plant, Gatun, **P-11,** 114.
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  Panama R. R. with Isthmian Canal Commission, **P-11,** 501.

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Construction and Engineering. (See Nos. 40, 145, 163, pp. 2362, 2364, 2365, 2366 of this Index.)
  1909. First division, O. C. E.: Under Lt. Col. H. F. Hodges, assistant chief engineer. Has charge of design of the locks and dams and their appurtenances. Considers and reports upon all questions of a civil engineering character "that may arise in the progress of the work."
  Locks: Designs for upper locks at Gatun and the locks at Pedro Miguel finished. Locks in pairs; separated by a wall 60′ thick, are 110′ wide, with 1,000′ usable length.
  Locks, filling and emptying: Longitudinal culverts in the side walls used, operated by Stoney valves; from these valves the water

passes through laterals under the floors and perpendicular to the axes of the locks, from which openings upward admit water to or draw it from the lock chambers. A longitudinal culvert is placed in the center wall also, connected with the lock chambers by laterals; but in this case, while the water in the main culvert is governed by Stoney gates, flow through the laterals is controlled by cylindrical balanced valves capable of withstanding pressure from either direction. The arrangement permits the passage of water from one lock to the other of any pair.

Gates: Double-leaf, double-sheathed, straight, mitering gates were adopted. Two barriers must separate high levels from the level next below in locks. Horizontal rolling gate abandoned in favor of another set of mitering gates with a chain barrier controlled by capstans in the wall. As over 95 per cent of the vessels of the world are less than 600′ long, intermediate gates introduced as a feature, dividing the lock chambers into two parts suited to vessels of 550′ and 350′ length, respectively; also protected by a chain barrier.

Guide piers: Both up and down stream.

Towing: Electric towing machines being designed.

Emergency dams: Swing bridge from which girders and wickets are to be lowered, to be provided. **P-09,** 2, 3.

1910. Description of locks, as well as drawings of designs for upper locks at Gatun and for locks at Pedro Miguel published in report for 1909. During year drawings prepared as were needed by working forces engaged in construction of locks. General features of intermediate and lower locks at Gatun and Miraflores adopted.

South approach wall at Pedro Miguel designed of massive concrete, and larger part of it is constructed. Northeast wing wall to be of massive concrete, and reinforced concrete walls designed for northwest, southeast, and southwest wing walls in same locality. Designs for approach wall at Pedro Miguel and Gatun and Miraflores tentatively prepared.

Description and drawings of valves for controlling flow of water into and from locks given in last report. Contract entered into Mar. 2, 1910, for all the frames for gate valves to control main culverts for upper Gatun and Pedro Miguel Locks; delivery begun. Contract entered into July 10, 1909, for frames and moving parts for two sets of Stoney valves.

40 cylindrical valves contracted for July 10, 1909; 90 per cent delivered. Substitution of cast iron for steel. Bids asked for remainder of ironwork for valves for main and lateral culverts.

General and detailed drawings of lock gates for all gates required to fully equip the locks completed. Bid of McClintic-Marshall Construction Co., Pittsburgh, Pa., accepted. Prices 3.785 cents per pound for structural steel erected, 2.62 cents per pound for structural steel not erected, and $5,374,474.82 for entire work. McClintic-Marshall Construction Co. bind themselves to complete work by June 1, 1913.

Design of machinery for Stoney gate valves for main culverts completed. Valves will be operated electrically. In order to try out the machinery as designed, before purchasing the large number required, specifications prepared and bids invited for two machines of each class.

Study given to question of machinery for operating gate leaves. As result, recess in wall modified to permit freer exit of water around miter post when gate is near position of rest, and type of machine adopted in which the force applied increases and the rate of motion decreases near the beginning and end of the movement. Crank-shaft motion chosen. It has been thought desirable to provide on gate leaves a positive lock. Device adopted will be tried carefully before being applied.

Design for spillway dam at Gatun completed. The trace of the dam is a semicircular arc, which secures not only necessary development of crest, but also partial neutralization of energy of converging stream that will flow over it. To help destroy energy of flow, two rows of baffle piers placed on arcs of circles concentric with dam. Crest of dam divided into 14 bays 45′ wide, by 13 piers and 2 abutments, closed by Stoney gates. Ample provision made to take care of floods, even should there be any negligence or delay in the operation.

As spillway channel must be used for discharge of the Chagres during building of main dam, construction of spillway dam will be one of last parts of work completed. Piers about 20′ apart therefore built from the foundation projecting above low water; stop planks can be placed between them, thus forming cofferdam, under the protection of which concrete can be placed. Design also contemplates construction of 4 low-level culverts, 3 regulated by Stoney valves and 1 by cylindrical valve. By their aid lake level can be regulated during construction of remainder of dam, concrete being kept ahead of slowly rising lake surface. Culverts will subsequently be filled with concrete.

General plan of machinery used in raising and lowering Stoney gates on crest of spillway prepared.

Design prepared for electric locomotive to tow vessels through locks and have full control of them from approach until locked through.

Work on movable or emergency dams continued; various details settled, and drawings being prepared to invite bids for delivery of material and erection in place.

Investigation of expenditure of water from Gatun Lake as affected by design for locks carried on. Results indicate that in ordinary years there will be a considerable surplus of water, and that water supply of worst-known dry season for last 19 years, 1908, would be sufficient to maintain through canal an average daily number of passages three or four times as great as average number passing Suez Canal.

Water supply is ample for canal as planned, and separation of locks into single lifts would have carried with it a great increase in expense to bring about an unnecessary saving in water supply. Analysis of effect of use of different lock chambers upon water supply, levels, and lifts. **P-10, 2-5.**

1911. Scope of division increased to add design and construction of aids to navigation, inspection of manufacture and erection under contract or otherwise of lock gates, operating machinery, gates and valves, emergency dams, and of placing of such concrete in locks as must be omitted until machinery is installed.

General plans of all locks practically completed. Designs for approach walls at all locks, with exception of south middle approach wall for Miraflores, prepared.

Contracts for valves, frames, and bulkheads practically completed. New contracts entered into, or advertisements issued, for remaining frames, valves, snubbing hooks. spillway gates, spillway bridges, and all fixed steel for completed locks. 954 tons of castings for structural material made at Isthmian Canal Commission shops at Gorgona.

With view of ascertaining friction coefficient and leakage under working conditions, tests of rising stem or Stoney valves undertaken at Gatun. Tests for determining coefficient and leakage under working conditions being made. One of the cylindrical valves tested for leakage at Pedro Miguel under head of 65.

Material under contract for fixed parts pertaining to miter lock gates delivered. Work in progress under contract June 21, 1910, for construction of gate leaves proper; shops had completed on June 30, 1911, ready for shipment, practically all material for 8 leaves 54′ 8″ in height, comprising upper guard gates in Gatun and Pedro Miguel Locks; 8 leaves 77′ high for the upper and middle gates in the upper lock at Gatun nearly completed, while 8 more leaves 77′ high for safety and lower gates in same lock about half done. Shipments, about 7,000 tons. Output of shops has reached about 900 tons per week, or nearly 1½ leaves.

Under the contract, erection of gates to begin on Jan. 1, 1911, at Gatun, and on Mar. 1, 1911, at Pedro Miguel. Contractor's erection plant practically ready on dates mentioned, but actual erection not begun until later, due to delays. By end of year skeletons of 4 leaves at Gatun were in position for a height of 4 panels and those on east chamber completely riveted.

Fender chains to be placed about 500′ above and 230′ below the upper and lower guard gates, respectively, in the locks at Gatun, Pedro Miguel, and Miraflores, and also at points 80′ and 100′, respectively, above the hollow quoins of the middle and safety gates in the Pedro Miguel Lock, and in the upper chambers at Gatun and Miraflores. Study of the device had made sufficient progress to determine type of first sample machine to be bought. Trial with sample chain will determine character of the remainder to be installed.

To permit examining, cleaning, painting, and repairing lower guard gates, and access in the dry to sills of the emergency dams, proposed to provide floating caisson gates; design of the molded ship type prepared. Alternative design of type now used for dry docks in U. S. under consideration. Caissons will be equipped with electric motor-driven pumps for use in pumping out caissons and for unwatering locks.

Bids for operating machinery for valves not satisfactory and rejected. New bids issued; contract made for purchase of two machines of each type for trial. Motors and limit switches for two machines purchased. Bids invited for purchase of machines for operating and locking the gates.

Plans for emergency or movable dams completed in Dec., 1910, and work of constructing and erecting them in place advertised on Jan. 14, 1911. Contract awarded to U. S. Steel Products Co. for sum of $2,238,988.40, lowest bidder. Time pledged for completing erection of the dams as follows: At Gatun, Aug. 15, 1912; at Pedro Miguel, Jan. 15, 1913; and at Miraflores, June 15, 1913. Machinery for raising and lowering wicket girders of emergency dams and gates which close openings between these girders designed and included in the above-mentioned contract.

Study given to electrical system for operation of canal. Contemplates hydroelectric station on Gatun Dam with reserve generating station at Miraflores operated by steam. Two stations to be connected by transmission line. Specifications for equipment of hydroelectric plant ready for issue.

Detailed drawings for Gatun Spillway and general plan of Miraflores Spillway completed, as well as drawings for steel footbridge to span gate openings at spillways, and for caissons which replace defective gates and permit repairs.

Scheme for lighting canal prepared and adopted. Contemplates range lights for establishing direction on longer tangents, and side lights about a mile apart to mark side of channel. Light and fog signal located on west breakwater in Limon Bay, and gas and nun buoys will be placed to mark channel to Mount Hope Dry Dock. Three types of lighted beacons will be used, of reinforced concrete. Project contemplates 34 tower beacons, 57 beacons, 57 gas buoys, 76 spar buoys, and 7 nun buoys. Reference targets for marking ranges where lights not used and for fixing location of gas buoys will be erected. Sailing lines marked by range lights, except at entrances to canal, will be so placed that all ships will follow course 125′ to their starboard of axis of canal; two passing ships, on their ranges, will have center line 250′ apart. For locating and referencing gas buoys, and providing unrestricted view of range and reference targets, 1,000 acres of land must be cleared. Work begun Apr. 20; at close of year 375.5 acres cleared, 148,000′ of trochas cut, and 16,000 lineal feet profile taken.

In the report of the Isthmian Canal Commission for 1899–1901, Mr. S. H. Woodard discussed the effect upon the lock gates of the difference in densities between the water on the two sides of the gates of the lowest locks. In the course of the design of the lower portion of the lock flights at Gatun and Miraflores it appeared that the pressures might prevent the opening of the gates, or even under possible conditions bring such pressure on the downstream side as would expose the operating apparatus to reverse stresses, etc. Questions considered by board; board reported it possible to find for a given condition of density, depth of water, and location of culvert, an elevation for outlets of culverts at which there will be no resultant unbalanced pressure on the gate leaves due to difference in density of water on the two sides after flow through the culvert has ceased. Applying analysis to known conditions at lower gates at Gatun and Miraflores, board determined positions for the outlets of culverts and recommended they be placed at these elevations in horizontal plane of roof of culvert, thus directing flow upward. It also recommended placing of valves in lower guard gates to provide against pressures due to tidal action. As a result, a design for outlet of culverts in lower locks adopted. **P-11, 2-5.**

1912. General plans for lower portion of lower locks at Gatun and Miraflores completed and approved, as well as plans for south middle approach wall at Miraflores and for uncompleted portion of south middle approach wall at Pedro Miguel, which was changed from solid type already built to reinforced cellular type for remainder. In addition, all drawings required for decking over various machinery chambers in the lock walls, snubbing posts, and spring buffers prepared, so that all detailed plans for locks completed and approved.

Chambers prepared for rising stem gate valves by lining up fixed irons, and 12 completed at Gatun and 2 at Pedro Miguel during the year; at Gatun 12 valves placed in position. In addition, 6 bulkhead gates placed in side-wall intakes and 6 in center-wall intakes at Gatun. Three rising stem gate valves and 1 cylindrical valve placed in Gatun Spillway. Cylindrical valves placed in all the locks during construction and all of them in position.

To determine probable leakage around rising stem valves, also force required to start valve and maintain motion, test made on set of two valves installed in upper valve chamber of west side culvert at Gatun. Entrance to culvert closed by water-tight bulkhead, and culvert between bulkhead and valves, with well above valves to top of wall, filled with water. By this arrangement there was greater head against valves than will obtain when lock is pumped dry for examination, and considerably greater than the usual operating head. It had been assumed at 31,750 pounds in design of machinery which was intended to exert a lifting force of 60,000 pounds, including all friction and weight of valve and accessories. Probable that both friction and leakage will be reduced in subsequent valves, as certain improvements in detail and workmanship are found in those of later construction.

Cylindrical valve in locks at Gatun tested for leakage from exterior by constructing bulkhead across entrance to valve chamber, which was then filled with water. When head reached 60′ leakage found to vary from a quantity too small to measure to about 0.25 of a cubic foot per second. Average was about what was to be expected from the tests made at Pedro Miguel and described in last report. Examination indicated that leather seal or gasket sufficiently rigid to hold up movable portion of valve and prevent seating properly. Segments which clamped leather seal removed and edge beveled slightly to allow easier bending of gasket. After this was done leakage found by measurement to be about 0.015 of a cubic foot per second, or about one-tenth of that previously measured. Segments for all valves being beveled in manner indicated.

Two rising-stem valve machines furnished under contract tested and found to be satisfactory; contract entered into Dec. 5, 1911, for furnishing all parts for 114 rising-stem gate-valve machines without motors. After successful test of first two cylindrical valve machines, contract awarded, Oct. 25, 1911, for 118 additional cylindrical valve machines without motors and 12 auxiliary culvert valve machines without motors. Up to June 30, 1912, 21 rising-stem valve machines (except valve stems and thrust screws), 34 cylindrical valve machines, and 3 auxiliary culvert valve machines received. Delays in shipment occurred, caused by strike of stevedores at Baltimore.

Owing to the peculiar climatic conditions on the Isthmus, involving tropical heat and extreme humidity, and deteriorating effect of these conditions on insulation of electrical machinery, was necessary to investigate different kinds of insulation. 16 sample motors purchased, 2 from each company offering bids for motors required. 8 of these were sent to the machine contractors for operating tests on valve machines, and the other 8 shipped direct to the Isthmus, where they were subjected to extreme conditions specified in specifications accompanying the invitation for bids, to test insulation. They were first placed in storehouse at Gatun and exposed to ordinary conditions of climate for about 2 months, during which time condition of insulation was determined periodically by inspection and tests. They were subjected to steam test, in which the extremes of temperature and humidity mentioned might be reproduced. In order that conditions of all motors might be identical, motors were placed in small building erected for the purpose and tests performed on all motors simultaneously, so that motors were subjected to same humidity and temperature. Tests consisted of filling building with steam, maintaining temperature of 50° C. for period of 10 days, making potential tests and measurements of insulation throughout this period. In addition to steam test, motors which survived were immersed by filling case with water at 30° C. and maintaining this condition for 5 hours, during which time observations of insulation resistance made continuously. 8 motors which were first shipped to the machine contractors were, after reaching Isthmus, subjected to the immersion test, but not steam test. Tests were conducted without the presence of any representative of manufacturers.

Relative standing of various types of insulation definite and choice of most suitable insulation clear; however, in view of the number of motors tested, it was desirable to obtain a numerical basis of comparison. A schedule of the various stages of the tests was therefore prepared and a number of points assigned for the survival of each of these stages. Contract awarded on basis of tests as above outlined.

Series of tests also made on sample limit-switches purchased under similar conditions as motors and award made. Satisfactory progress made in manufacture of these switches, and at end of year 50 reported shipped.

Lock gates being constructed and erected under contract dated June 21, 1910. During year shop drawings for different heights of gates completed and approved. Total steel plates and shapes accepted at mills, about 52,322 tons, which practically comprised all rolled material required, excepting that for spare parts. Three-quarters of castings made, machined, and accepted. Specified chemical and physical tests carried out and contract requirements as to quality of material fully met. Only change in material made in bushings for the pintles at the bottom of certain leaves that will always be in sea water. Certain leaves operated in brackish water are to be protected from erosion by use of zinc rings placed close to bronze bushings.

Total shipment of structural material to end of year 1912, about 39,000 tons, or 76 per cent of amount required. Of the total, about 32,000 tons shipped during year, so that on June 30, 1912, 13,000 tons remained to be forwarded—about half the material for the gates in intermediate locks at Gatun, the upper locks at Miraflores, and all material for gates in lower lock at Miraflores.

On June 30, 1912, erecting gates on Isthmus in progress on 23 gates. They comprised all gates in upper lock and intermediate gates in lower lock at Gatun and all gates at Pedro Miguel, excepting lower guard gate in west chamber. No material placed at Miraflores. Total steel in place in several gates at end of fiscal year, 19,631 tons, or about 34 per cent. With exception of 412 tons previously reported, all this material erected during year. Total number of field rivets driven to June 30, 1912, 963,500 out of 5,750,000, or only 17 per cent of total.

Completion of several gates fallen considerably behind dates specified in contract. Close and continuous inspection maintained; believed that completed gates will meet fully the standard laid down in specifications. Tests for water-tightness in first gate at Gatun indicate excellent workmanship.

First two miter gate-moving machines and first miter forcing machine completed and satisfactorily tested. Miter gate-moving machines installed in respective places, and one tested in regular service of swinging gate in dry. Operation successfully performed in 1 minute and 48 seconds, or 12 seconds less than estimated time. Contract for remaining 90 miter gate-moving machines made Feb. 11, 1912. Award for motors for these machines made.

Contracts entered into for delivery of one fender, except the chain, which was built at U. S. Navy Yard, Boston. To determine best form of emergency resistance valve, elaborate series of tests made in power plant of Prudential Insurance Co., Newark, N. J. Three types of valves tested; two satisfactory. Chain the only part of apparatus shipped.

Material for structural steel covers by which the electric locomotive track is supported over lock-gate recesses in masonry provided for, and erection of steel let by contract July 7, 1911. Erection of all covers in Gatun and Pedro Miguel Locks practically completed.

Bids for electric-towing locomotives invited. Contract entered into for delivery of one locomotive complete. Under contracts for materials in connection with locomotive tract, 95 per cent of structural parts completed. Delivery of steel rack sections 44 per cent completed. There was delivered on the Isthmus 60 per cent of malleable-iron supporting brackets for conductor-slot covers, but these rejected on account of general irregularities. Contract for malleable-iron cover plates and washers completed. Bids for crossovers and turnouts rejected. On readvertisement, contract entered into.

Specifications issued Sept. 9, 1911, covering main generating equipment for hydroelectric station, containing three 2,000-kilowatt units, to be located adjacent to spillway in Gatun

Dam. Equipment to consist of three 2,250-kilowatt water turbines, 3 head gates, 3 penstocks, 3 governors, 3 draft tubes, three 2,000-kilowatt generators, 3 direct-connected 50-kilowatt exciters, two 100-kilowatt motor-driven exciter sets, one 30-ton electric crane, and 1 lubricating system. Contract entered into Dec. 2 for hydraulic equipment. Contract entered into on same date for electrical equipment. One generator completed and ready for test. Only material delivered on Isthmus, 60 per cent of penstocks.

Sufficient water from storage in Lake Gatun to warrant installation of 6,000 kilowatts in generating capacity, including reserve. Maximum water diverted for hydroelectric development approximately 7 per cent of minimum water supply and is excess not required for lockages, evaporation, and leakage.

Spillway-gate machine designed to raise and lower, in 10 minutes, Stoney crest gate for controlling water levels of Gatun and Miraflores Lakes. Consists essentially of two counterweights, connected to gate by a screw and chain; screws driven simultaneously; counterweights practically balance weight of gate. Contract awarded for 22 spillway-gate machines.

Jan. 31 specifications issued for apparatus for remote control and indication of the lock machinery and spillway gates. Bids opened Mar. 15 and contracts awarded.

For supplying electric current to operate lock machinery, 16 transformer rooms provided in locks at Gatun, 8 at Pedro Miguel, and 12 at Miraflores. Power taken at 2,200 volts from hydroelectric station and transformed to 220 volts. Each room is to contain two 190-kilowatt power transformers. All equipment in duplicate. Transformer room will also contain 25-kilowatt lighting transformer, bank of 9 or 10 oil switches, 7-panel, low-tension switchboard, and miscellaneous cable and terminal equipment. Every effort made to render operations simple and foolproof.

General features of lock illumination fixed. Exterior lighting concrete lamp standards will be erected on coping of locks throughout length of each wall—211 lamp standards at Gatun, 131 at Pedro Miguel, and 169 at Miraflores. Standard supports reflector 30′ above the coping. For interior lighting of operating tunnels and machinery rooms, deck lights arranged. For use at night, artificial illumination provided by ordinary 16-candlepower carbon filament lamps mounted in specially designed reflectors set in concrete. 7,000 lamps will be installed in all locks.

Erecting lock machinery begun at Gatun Sept., 1911, and at Pedro Miguel Jan., 1912. Schedule of erection not adhered to in all cases, but installation and erection progressing as fast as deliveries. 9,414′ towing track, including conductor-slot channels, assembled, lined up, and tested, and 2,348.9 c. y. concrete laid in connection with towing track and miter gate recess covers.

Of emergency dams, 2,786 tons material shipped from U. S. Shipments to Isthmus delayed; only 1,700 tons received. False work and erection cranes for east dam at Gatun completed.

Contracts made for emergency dams and gate and girder hoisting machines; also for electrical equipment for operating machines. Satisfactory progress made; first machine of each type tested and other machines advanced. Tests of worm gearing carried out.

Work on drawings for floating caisson gates continued. Plans for various decks drawn out and detailed study made of pumps and piping.

Contracts aggregating $3,683,306.29 entered into during year for various irons in connection with locks, electric locomotives, tracks, machines, pumps, electrical equipment; for all necessary appliances for completely equipping the locks for satisfactory operation, except machinery for guard valves, and material for transmission line which will connect hydroelectric station at Gatun with locks of Pacific division.

Prolongations of range light tangents so covered by brush and timber that trochas had to be cut; 809.85 acres cleared.

Field forces organized and work begun on range towers at Pacific entrance Sept. 1, 1911. The towers, of concrete, being constructed by means of steel forms. Eleven of the towers completed—Nos. 5 and 6, Atlantic section; Nos. 2, 9, 11, 13, and 14, Pacific section; Nos. 1, 21, 24, and 25, Gatun Lake section. In their construction 805.88 c. y. concrete used. 60 gas buoys located, referenced, and checked, and 3 beacons in Gatun Lake section located. For floating buoys and for 23 towers and beacons in inaccessible places, compressed acetylene adopted. White lights will be used; all range lights, beacons, and buoys will have individual characteristics formed by flashes and combinations of flashes of light and dark intervals. Candlepower of lights will vary from 2,500 to 15,000. Most powerful ones will be those marking sea channels at Atlantic and Pacific entrances, visible from 12.5 to 18 nautical miles. Beacons and buoy lights will have 950-candlepower. **P-12**, 2-12.

1913. Designing work for locks, including drawings needed by working force in the field, as well as for spillways, approach piers, and wing walls, completed. After performing some work for second division on coaling plants and canal terminals, force in charge of designs disbanded June 1, 1913.

Complete installation for a set of rising stem valves requires setting valves, placing stems, roller trains, crossheads, motors, and control panels. Fixed ironwork for guiding valves and forming water seals required correction before installation begun. For valves at

Gatun and all but 2 at Pedro Miguel corrections made by chipping and grinding with pneumatic hand tools; for 2 at Pedro Miguel and all valves at Miraflores done by specially designed milling machine. 94 per cent of fixed irons corrected at close of year. During year 102 rising stem valve chambers prepared, including 50 at Gatun, 28 at Pedro Miguel and 24 at Miraflores, and 104 valves, including trains and sealing devices, placed in position in locks. Of this latter number, 48 at Gatun, 28 at Pedro Miguel, and 28 at Miraflores.

Tests made on 39 rising stem gate-valve machines at Gatun, 20 at Pedro Miguel, and 8 at Miraflores.

Six side-wall intake screens placed at Gatun, and bulkheads to center-wall intakes removed and placed in outlet. At Gatun 4 lower side-wall bulkhead gates also placed.

Guard valves provided as duplicates to upper rising stem valves in emergency, or for use in closing intakes in side-wall culverts for unwatering culverts to permit access to other valves for painting and repairs. Design of machinery for these valves completed Aug., 1912. Design determined by cramped position in which machines had to be placed; because of infrequency of operation, as well as slow speed, simpler and cheaper than for rising stem valve. On Nov. 14, 1912, contract awarded for 18 complete machines, excepting motors, limit switch, counterweight bases, and counterweights; 50 per cent of machines delivered before close of year.

Last of cylindrical valve machines under contract delivered Jan. 15, 1913. Mechanical installation of 120 cylindrical valves completed June 1, 1913, and electrical work of installing control panels and cables with necessary conduits for these machines 41.6 per cent complete for all locks. As result of tests, decided to regrind all valves. Operating machinery is same for both cylindrical valve and auxiliary culvert valve machines, except 60″ and 36″ strokes are required for 60″ and 36″ auxiliary culvert valves, respectively, instead of 32″ stroke of cylindrical valve. Test made to determine time required to open various types of valves; cylindrical valves required 10 seconds, 60″ auxiliary culvert valve 16 seconds, and 36″ auxiliary valve 10 seconds.

Tests of discharge made on cylindrical valve and 3 rising stem gate valves in spillway.

During year 14 gates and 1 caisson for spillway at Gatun and 8 gates and 1 caisson for spillway at Miraflores erected. Gates at Gatun installed in position on dam. Miraflores spillway under construction. Draft tubes for hydroelectric station on east side of spillway dam at Gatun completed.

All spillway gate machines and pumps for unwatering counterweight pits delivered and test made of first machine. Device for shifting gate upstream a slight distance after it is clear of the water and mechanism for raising roller train out of water operated properly. Mechanical work started on 12 of 14 machines at Gatun and 71 per cent of mechanical work on all machines completed.

Construction and erection of lock gates continued under contract with McClintic-Marshall Construction Co. dated June 21, 1910. Shop drawings completed, as was manufacture of all material for gates, aggregating 57,500 tons; final shipment made in Apr. In addition, 2,100 tons structural work for spare parts built and delivered on Isthmus. Spare parts comprise sufficient material for partly or completely rebuilding any 2-gate leaves on canal. Erecting lock gates proper began at Gatun May 17, 1911, at Pedro Miguel Aug. 7, 1911, and first work at Miraflores done Sept. 10, 1912. At beginning of year work in progress on half the total number in all locks; none had been completed. Total steel assembled only 19,361 tons, or about 34 per cent of total. Field rivets numbered 963,000, or about 18 per cent of a total of over 5,700,000. Work allowed to drag; completing it within reasonable time hopeless. Contractors decided upon change in local management and, Sept. 1, installed additional machinery, increased force, and arranged for efficient supervision. Improvements in organization became manifest; high degree of efficiency reached, with large increase in work. Some idea of improvement may be judged from fact that during Mar. 660,000 rivets driven, while the highest number driven in any one month prior to Sept. 1, 1912, was 213,000. On June 30, 1913, over 97 per cent of material assembled in gates. All leaves in west chamber at Gatun and in east chamber at Pedro Miguel stepped on pintles, and all leaves in west chamber at Miraflores excepting 2 leaves of operating gate in lower chamber. All guard gates complete except at lower end Miraflores Locks; and guard gates at both ends Gatun Locks permanently closed at end of year. Those at upper end put in service July 20, 1912, and lower guard gates closed June 11, 1913.

Supplemental contract entered into with contractors Jan. 14, 1913, by which certain restrictions governing payments modified, as original provisions proved unnecessarily severe and more speedy completion would be assured by relaxing. Modification provides for successive partial payments on each gate when assembling, riveting, finishing, and painting completed and accepted. Further supplemental agreement, signed May 20, 1913, gave extension of time. Delays occurred for which contractors could not be held responsible, due to shipwrecks and strikes, as well as delays caused by Isthmian Canal Commission. Rate under which liquidated damages to be computed increased, while new and later dates fixed for completion of several gates. June 1, 1913, fixed for upper guard gates at Pedro Miguel, and June 15 for guard gates at lower approaches to Gatun and Pedro Miguel and upper approach to Miraflores Locks. Lower guard gates at Miraflores to be finished Sept. 1, 1913, and all other gates necessary to permit lockage through one side of each flight, ocean to ocean, must be completed not later than Oct. 1, 1913, while date of final completion for all remaining gates fixed at Jan. 1, 1914, for Gatun and Pedro Miguel, and Mar. 1, 1914, for Miraflores. From progress made dates will be anticipated. Total weight of all gates on canal, excluding pumps, floats and float switches, motors and conduits, and other electrical apparatus, castings for attaching operating struts, and miter forcing machines, 57,552 tons. Castings and structural parts to be embedded in masonry in part furnished under contract for lock gates and erected by Isthmian Canal Commission in connection with concrete construction.

Entire shipment of miter gate-moving machines completed during May, 1913, but work handicapped by nonreceipt of parts necessary to embed in concrete and about which erection of whole machine hinges. At end of year 86 per cent of all machines installed. Electrical work in connection with these machines 24.2 per cent completed at close of year.

Miter gate-moving machines installed complete on upper guard gates at Gatun, and test made of machinery July 31, 1912. Gate-moving machines adjusted. Limit switches adjusted so that the gate traveled from its full miter position to opposite position in recess, at which point machine again on dead center. Operation of one leaf 1 minute and 51 seconds and for other 1 minute and 50½ seconds. Operation completed second time. Mitering of leaves perfect. Gates also had installed miter-forcing machine, tested out on same date. One leaf left in closed position and other opened 2″.

Miter-forcing machine brought gate to within ¾″ of perfect miter. Another trial, with opening of 3½″, brought gate to ⅝″ from miter. Several changes made, and new proposals invited. Under new contract all machines delivered. Installation delayed on account of noncompletion of work on structural gate parts.

Under contract entered into Nov. 4, 1911, all material for trial fender delivered. Erection begun about Jan. 1 and completed Mar. 1, 1913. During Mar. and Apr. tests made. Results seemed to warrant belief that vessel, unless of great size or moving at excessive speed, can be checked or stopped without breaking the chain. Great tidal range below Miraflores Locks made modified design necessary. Same system of cylinders used and machinery practically same, but chain is stretched across the lock at either of two levels, according to stage of tide. Chain is endless.

Plans and specifications for floating caissons completed and invitation for proposals issued May 23, 1913. Caissons will be used for closing upper and lower entrances to lock chambers when unwatering them, and will contain pumping plant for pumping out locks. Pumping system will include 4 centrifugal pumps of volute type with 20″ discharge, besides small auxiliary pump. Flooding of caissons done by gravity and 2 of the 4 large pumps arranged for pumping them. All remaining parts of towing track material delivered. Total delivered, 53,950 linear feet, and at close of year 36,908 linear feet installed complete with concrete, and 11,168 linear feet distributed and bolted up ready to be aligned and concreted. Installation of most of return track performed by Atlantic and Pacific divisions.

Bids invited for towing locomotives on design prepared by electrical subdivision, and contract entered into for locomotive. Locomotive delivered Jan. 25, 1913, and ready for operation Feb. 7, after which it was tested. Test developed defects. As a result, order placed for required number of locomotives on design submitted by General Electric Co., abandoning design of Isthmian Canal Commission.

Tests made in Limon Bay on ships of Panama R. R. fleet, at various speeds of acceleration, to serve as check on basis used for design of locomotives. Ships ranged from 3,500 tons to 10,400 tons displacement. Tug used which could exert maximum pull at standstill of 15,000 pounds. Readings taken of dynamometer pull, tug speed, angle of tow line with center line of tug, angle of tow line with ship, and ship's bearings, at intervals of 30 seconds throughout the run.

Insulated cable on order to date for all classes of work on locks and hydroelectric station, including underground lines from hydroelectric station to locks, aggregates 2,372,110′, of which 1,394,600′ lead-sheathed cable and remainder rubber-covered double-braided wire and cable. 93 per cent of total required delivered. 462,729′ of lead-sheathed cable pulled into ducts, and large part of remaining ducts rodded, cleaned, and wired with fish wires for pulling in remainder. Cable pulled in ducts by special winch made on Isthmus.

Control scheme for various locks completed; contemplates control of every piece of machinery in lock walls from central station. In house is located control switchboard connected with every local control panel and indicating mechanism. Switchboard so arranged that indicator and control switch of each gate or valve machine is placed in same relative position to other indicators and control switches as that occupied by actual machines, so that by means of red and green lights and small models of gates and valves operated by synchronous transmitting mechanisms operator in the control tower on locks is able to tell at a glance condition in any part of locks from switchboard indications. Expected first board will be shipped by Aug. 1.

Hollow concrete pole with concrete bracket arms and reflectors designed by architect for supporting lamps for exterior illumination of locks and grounds. Poles arranged in 4 rows along length of locks, spaced 100′ apart, with lamps 30′ above coping level. Lighting units used, 110-volt, 500-watt Mazda lamps.

Generating equipment for hydroelectric plant delivered, including main generators and turbines, exciter sets, traveling crane, penstocks, head gates, and operating machinery. Steelwork for hydroelectric station purchased, and delivery completed. Erection of penstocks complete and turbines set. Balance of installation dependent upon completion of building for housing electrical equipment.

Decided to install for transmission line overhead system of 44,000 volts, from Balboa to Cristobal, connecting Gatun hydroelectric power station with present Miraflores steam power station. Four substations provided—at Cristobal, Gatun, Miraflores, and Balboa. Complete line consists of duplicate 3-phase lines.

Remaining shop drawings for emergency dams completed and approved. Tests made upon gates prior to shipment. Structural material for turning and wedging machinery for emergency dams shipped to Isthmus. Assembling of east dam at Gatun begun July 1, 1912, and completed Mar. 1, 1913. Erection of west dam begun Nov. 9, 1912, and practically completed in 5½ months, or Mar. 1, 1913. Material for west dam at Pedro Miguel received in time to begin erection Feb. 1, 1913; all material assembled. Work begun Apr. 1, 1913, on east dam, and by June 30 over 50 per cent of material assembled in structure and 30 per cent of riveting completed. Delivery of material for east and west dams at Miraflores began May 1, 1913, and to end of fiscal year about 840 tons received. Erection of east dam begun June 1, 1913, and of west dam June 13, 1913. On May 20 contractor began final tests of dam on east side at Gatun, total time for closing, first test, being 1 hour 1 minute and 30 seconds. Second part of test started, consisting of operating turning and wedging machinery for 20 days, at intervals depending upon heating of motors. Tests were made principally for limbering up turning and wedging machinery. After completing second part of tests, 3 additional complete operations made; the last completely closed passage in 42 minutes and 17 seconds—19 minutes and 13 seconds less than time of first test.

12 range towers completed, of reinforced concrete, with heights from base to focal plane varying from 28′ 10″ to 87′ 10″. 3 skeleton tower beacons, marking edges of channel, Balboa to Miraflores, completed. 18 concrete-steel reference and range targets completed in Gatun Lake section. There will be approximately 32 of this type, by means of which gas buoys may be located from previously determined angles. At Bohio, Pena Blanca, Caimito, Mamei, Juan Grande, and Bas Obispo these reference targets also form unlighted ranges which mark axis of short tangents at those places. Reinforced concrete caisson for west breakwater light and fog signal, begun in June of last year, completed to height of 25′ and was sunk at inner end of Limon Bay in 20′ of water, where it will remain until its riprap foundation at outer end of breakwater has reached settlement. Plans for west breakwater light and fog signal revised under supervision of architect and revised structure supersedes one shown in last report. 51 concrete buoy sinkers 48 by 48 by 26″ and forty-five 24 by 24 by 18″ constructed at Balboa plant of lighthouse subdivision. Reinforced concrete wharf 70′ long and 30′ wide, adjoining small boat landing at Gatun, built for lighting establishment of canal by Panama R. R., to be used for storing, painting, and repairing gas and spar buoys belonging to Gatun Lake section. Experiments made with tungsten lamps having spirally wound filament concentrating the light source to spheres of ⅜″ for 100-watt and ⅝″ for 150-watt lamps, as that type of lamp will be used throughout for all electrically lighted range towers and beacons. Experiments made for special flashing devices and lamp shifters for electrically lighted towers and beacons.

250 acres of prism from San Pablo to Pena Blanca cleared of trees and brush, and approximately 180 acres of land were cleared of trees in the vicinity of Mamei for the dredging division. **P-13,** 2-13.

(See p. 2368 of this Index.)

Construction, Plan of. (See p. 2365.)

Outline of, as proposed by John F. Wallace, before Board of Consulting Engineers, 1906. Unit costs and time. **P-06*,** 364-371.

Terminal channels should be dredged to permit receiving material; Colon Harbor should be protected from northers; embankments to be thrown up on each side of the canal with dipper or clamshell dredge as far inland as possible, to keep flood waters out of canal section, to retain material excavated from the canal by hydraulic dredges, and to provide roadbed for the Panama R. R.; this location of the railroad would do away with the construction and maintenance of bridges; operation of canal will increase traffic of railroad; should be operated with electric power got from Gamboa Dam; track necessary perhaps on west side in central division; dredgeable section through the lowland between La Boca and Miraflores to be constructed in like manner; two end sections of the canal to be completed as soon as possible, "in order that dredges might work as far inland as practicable to assist in the attack on the principal excavation through the divide. This work can be performed by dipper dredges of from 5 to 10 c. y. capacity, loading the material on seagoing barges, and dumping it in deep water beyond the harbor limits."

Various unit prices estimated for soft dredging, rock work, etc.

"The limit of time that it will require to complete the canal or put it in operation will depend upon the removal of the 8 miles of central excavation, containing approximately

100,000,000 c. y., for canal section 200′ in bottom width, 50′ berms, and slopes of 1 on 1."

"The time required to do this work is dependent upon the excavating units which can be installed and the capacity per unit, which in turn is dependent upon the promptness with which empty cars are furnished to the steam shovels and loaded cars removed. The efficiency of the entire operation rests upon the plan of tracks, the quality and amount of motive power; the number, capacity, and character of the cars; the provision of adequate and proper dumps, and dumping facilities."

10 steam shovels operating Jan., 1906; 37, Jan., 1907; 58, 1908; 82, 1909, would bring output up to 16,400,000 c. y. annually. Same rate during 1910, 1911, 1912, and 1913, excavation would amount to 111,400,000 c. y. at the end of 8 years from Jan., 1906. "In the meantime the excavation of other portions of the central excavation outside of the 8 miles could be carried on partly by steam shovels, etc." Canal could be opened for navigation within 8 years and and completed in 10—at most, in 12 years.

Sketch showing typical cross section of canal, on the terrace plan.

Dumps: Existing dumps and tracks practically those of the French company; "lack of track material, labor, and other appliances prevented any material changes being made." Wallace finally had 4 distinct main track railway systems leading from the excavation to distant spoil banks, 2 at each end of the central excavation and 1 on each side of the canal axis; these track systems to consist of 2 or more main running tracks as requirements might determine, using the Panama R. R. as a base; part of this plan consisted of a main double-track railroad leading from the Culebra excavation to the Gamboa Dam site, over which excavated material could be delivered at the site of the dam for construction purposes; main track systems to be balasted with stone and maintained in first-class condition for rapidity of movement; ample side track facilities to be provided; trackage provided and arranged so that it should not be necessary for a steam shovel to wait for a car; lock tracks to be at the dumps; high and low dumps to receive study; location of dumps such that after the first mile an extra haul of 10 miles should cost but 2 cents per c. y. for transportation alone.

In the preparatory work the first step to remove the slippery clay formation overlying the Culebra excavation, during the dry season; slides afterward can be controlled, "in the opinion of the writer"; central drainage excavations at both ends of the cut; extraordinary efforts to be made to sink the central excavation to the greatest possible depth.

60 cents per c. y. estimated for removing central 5 or 8 miles of excavation; increase of 10 per cent over previous estimate of 50 cents due to 8-hour law, "and by the conclusion which he has also reached, that to obtain efficient and economical results it will probably be necessary to contract this work, on account of the delays and difficulties which surround the prosecution of the work the details of which are carried on under direct Government control." **P-06***, 364-370.

Construction, Status of. (See p. 2364 of this Index.)

Inspection of condition of work after resignation of Chief Engineer Wallace, made by Isthmian Canal Commission No. 3, **P-05**, 5.

Outline of conditions when Chief Engineer Stevens took charge, covering operations from Feb. 1 to June 30, 1905, **P-05**, 124.

June, 1904, to Mar., 1905, the work in connection with the investigations and surveys relating to the construction of the canal carried on as outlined by the commission in 1904. The assistant engineers appointed prior to July, 1904, reported direct to the chief engineer, but after the investigations intrusted to them neared completion and the work expanded, divisions were organized and different residencies placed under the charge of the division engineer. June 30, 1905, the engineering department comprised 5 divisions and 8 so-called bureaus. **P-05**, 124.

Report of Gen. Hains and Maj. Harrod, members of Isthmian Canal Commission No. 3, dated July 17, 1905, as to what had been accomplished under Chief Engineer Wallace. Records of latter's office examined, works along the line examined, and engineers in direct charge of work consulted. List of reports found on file. Outline of what had been done on Culebra division, Colon construction division, by bureaus of water works, sewers, and roads, of architecture and building, and of machinery and equipment. Report accompanied by letter, dated July 14, 1905, of W. E. Dauchy, acting chief engineer, showing the amount of work accomplished under Mr. Wallace, and the improving progress made toward organization, with an outline of the vast number of unwonted difficulties which had to be overcome. **P-05**, 133.

After observation of status of canal work under Mr. Wallace, apparent that good work had been done in preparation. Better, however, if attempt to "dig dirt" at Culebra had not been made. **P-05**, 145.

Progress made, extent of, at Feb. 14, 1905. Water supply for towns; administration of department of material and supplies satisfactory; entire work of the department of sanitation has been prosecuted in an efficient manner and with gratifying results; needful to make arrangements for increasing forces, and for resulting housing accommodations. **P-05**, 302.

Preparatory stage virtually past, at date of annual report, for year ending Dec. 6, 1906. Ready to enter upon actual work of canal construction. Thoroughness of preparatory work testified to by Senate Committee on Interoceanic Canals, in its majority report, May 17, 1906, after an investigation covering a period of 6 months, embracing every detail of the work and every act of the canal officials. From this report, "The work authorized by the Spooner Act has been initiated and extensive preparations for a rapid prosecution of it have been made. The Canal Zone has been placed in a satisfactory sanitary condition, adequate shelter for the workmen has been provided, hospitals of very large capacity have been made ready, as is evidenced by the opinions of experts who have testified before the committee, and we are fortunately now in possession of a vast array of facts and figures affecting the prosecution of the undertaking that have not until now been available. This is due to the fact that the preparatory work has for two years been prosecuted with patient, intelligent judgment and earnest effort by those intrusted with the direction and supervision of the work." **P-06,** 1, 2.

Consuls. (See Countries, foreign; see No. 93, p. 2363 of this Index.)
  Department of State issued circular note saying that consular officers commissioned to the President of Panama and recognized by him might exercise their function within and with reference to the Canal Zone without recognition from the U. S., **P-05,** 48.
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  Acts, consular services, **P-13,** 607.

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Contracts. (See Nos. 23, 163, pp. 2361, 2364 of this Index.)
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Contracts, Construction of Canal by. (See No. 163, p. 2364 of this Index.)
  Bids for canal construction asked from large contractors, Oct. 9, 1906, the accepted groups to be paid upon the estimated reasonable cost of the actual construction as fixed by an engineering committee, etc. Bids to be opened Jan. 12, 1907. **P-06,** 15.
  Letter of chairman of Isthmian Canal Commission No. 3 to Sec. of War setting forth reasons why construction of canal by contract seems advisable. **P-06,** 128–131.
  U. S. will get benefit of the combined efforts of the best and most experienced contractors in the world; will secure cooperation of "those powerful interests" in keeping full the ranks of employees; the U. S. will know exactly what the work costs in every part; plan offers incentive for speedy and economical construction by the penalizing system; * * * "friction will be avoided"; "probable saving to the U. S." **P-06,** 130.
  Invitation for proposals to complete the construction of the ship canal upon the Isthmus of Panama between the Caribbean Sea and the Pacific Ocean, Oct. 9, 1906. For 85′ lock-level ship canal, having a minimum depth of 41′ and a minimum width at bottom of 200′, between deep water in the two oceans. Basis of proposal: Qualifications of bidders; bonds; general directions for bidders; information furnished by commission; rejection of bids. Proposal form: Bond form; form of contract. Articles: Work to be done by contractor; extra work; plant and facilities furnished by the commission; functions reserved by the commission; to be supplied by the contractor; obligations to be assumed by contractor; payments; final compensation; method of estimating cost and time of construction of canal; default by the contractor; termination of contract when contractor is not in fault; decision of the chief engineer; definitions; bond for fulfillment of contract. **P-06,** 132–150.
  Contract versus hired labor construction direct by U. S.: Sealed proposals invited Oct. 9, 1906, for building canal by contractors. Bids opened Jan. 12, 1907. None satisfactory. Contract work in U. S. generally cheaper; where he does not have to use special plant; illustrated by various instances where U. S. did its own work cheaper than through contractors. To be remembered that U. S. does not seek to make a profit when it undertakes a construction. Doubtful if any U. S. contractor could bring to the Isthmus any better labor organization than could the U. S. itself. No contractor can even attempt to recruit labor from the West Indies; no objection from any Government to their laborers working under the U. S. direct. Experience of the U. S. as a contractor equal to that of any contractor. In case of labor troubles, U. S. can handle the problem better apparently. More likelihood of continuity of construction by U. S. direct con-

struction. Reference made to the fact that in a majority of contracts on public works the time limit has to be extended. "There is no question that there are a number of people who will always believe and contend that any piece work done by the U. S. could have been done as well and more cheaply if undertaken by contract, but an examination of the records will generally disprove such a contention. On the other hand, there is an equally large class who will contend to the contrary and claim, after the completion of the work, that the reverse is true." Questionable if a contractor could get more work out of the laborers of the Isthmus than could the U. S. At Culebra all the plant secured, organization has been built up, labor obtainable; some of the organization composed of former contractors or overseers for contractors. No advantage in letting that section out to contractors. Dredge plant being steadily augmented for prism work. No advantage in seeking contractors' equipment, etc. Dam work intimately connected with rock work at Culebra and dredging elsewhere; no gain discernible in letting such work to contractors. In lock construction, the acquaintance with competent men for this work is more extended on the part of the U. S.; no question but that the U. S. should furnish all the cement; no contractor possesses the necessary plant for handling the enormous quantities of concrete required for these structures. The gates and operating machinery can, it is believed, best be constructed by contract at the proper time. Sanitation could probably be managed better with the whole work under direct construction by the employees of the U. S. "The relative advantages of the contract system, etc., * * * very different to-day from what they were two years ago. * * * 80 per cent of the entire plant needed for the construction of the canal purchased and contracted for. Machine shops have been erected and equipped for making all needed repairs to the machinery now on hand. * * * The U. S. better equipped to carry on the work as advantageously and economically as any contractor. * * * Thousands of employees have been secured, and an effective working organization has been perfected, and the recruiting system put in operation is capable of furnishing more labor than can be advantageously used. The employees are well sheltered and, in general, well fed; the salaries paid are satisfactory and the work is progressing smoothly. A change from these favorable conditions in the method of prosecuting the work would disorganize all existing conditions and would undoubtedly increase the estimated cost and time of completing the canal. The conclusion that the work can be done better, cheaper, and more quickly by the U. S. has been reached only after free and full discussion by the various members of the commission and the higher officials connected with the construction work, and after careful consideration of all sides of the proposition." **P-07,** 16-24.

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Cost Keeping. (See 250, p. 2367 of this Index.)
System: Begun July 1, 1907. Monthly statements prepared showing the cost of each principal piece of work. Cost based on engineers' monthly reports, and general expense reports, the first covering engineering proper, and the second covering general expenditures, such as Isthmian Canal Commission direct expense, Disbursing Officer, Examiner of Accounts, etc. Civil administration charges are omitted, "because they are not useful in a comparative statement of the work proper, although necessary to the construction of the canal as a whole, and because they were not incorporated in the estimates of the minority members of the consulting board, whose plans are being executed."
Plant cost: Not included at 1908, because all plant necessary for the completion of the work not on hand.
Building construction: Cost included, except those items chargeable as aforesaid to civil administration.
Balance of cost with funds: "The monthly cost of each piece of work * * * balances with the amount charged to the same work on the books of the disbursing officer." **P-08,** 21, 22.

1909. Purpose to enable a comparison of cost of work between any two periods. Improvement already evident. New system of accounts effective July 1, 1909, expected to give better results. **P-09,** 19, 20.

1910. Effective July 1, 1909, the subaccounts of the Department of Construction and Engineering were contained in (A) construction work, and (B) plant and plant arbitraries established as basis for construction work. By taking up monthly proper proportion of charges for plant and equipment expenditures, plant charges will have been completely absorbed by work on its completion.

Division cost of an item of construction work made up of cost of all labor and material directly applied to work, plant, arbitrary and proper portion of general administration expenses, including expenses of O. C. E. and other general engineering expenses. To division cost must be added proportion of general expenses of the Isthmian Canal Commission, including expenses of Quartermaster's and Subsistence departments, Examiner of Accounts and Disbursing Office, proper share of expenses in U. S., and all other miscellaneous charges, in order to arrive at total cost. **P-10,** 34.

1911. Methods revised from time to time, and that adopted Jan. 1, 1910, continued without change. Cost-keeping accountant, Mr. Ad. Faure, reports directly to Chief Engineer, and his duties consist in supervising and verifying statements of costs furnished by division engineers, establishing accounts for new work, and preparing statistical reports.

In examination of construction expenditures, Central division seems to bear more than its proper proportion of general expenses, due to fact that prior to 1907 but little work done except in this division, so that nearly all overhead charges properly chargeable to it.

Unit costs during year lower. Central division produced lowest cost for excavation, and, as between the terminal divisions, that done in Pedro Miguel Locks lower by 11 cents than in Gatun Locks, but higher by 19 cents than that done in Gatun Spillway. Excavation for Miraflores Locks highest. In preparation of foundations Atlantic division did work for less than Pacific division. High cost at Pedro Miguel partly due to layout of work and partly to changes in designs increasing amount to be done at a time when excavation could not be economically handled.

In dredging, Atlantic division secured lower costs with seagoing suction and dipper dredges, and Pacific division with ladder dredges. In latter division underestimate of quantities resulted in total plant charge being absorbed with accounts for Apr. Masonry laid during year, 1,741,908 c. y. in locks and spillways. In Pedro Miguel Locks the average division cost was $4.7040 per c. y., and in Miraflores Locks $4.6826; in Gatun Spillway, $6.7044; and in Gatun Locks, $6.5919. Difference between costs in Atlantic and Pacific divisions mainly in cost of cement, sand, and stone. Bulk of cement used in Atlantic division received in barrels at cost of $1.19 at tidewater in U. S., while Pacific division received its cement in bags at cost of $1.60 per barrel, less credits for bags. As 90 per cent of bags were returned, cement in bags cost $1.01 per barrel at tidewater in U. S. Construction plant in Pacific division also handled large percentage of cement directly from cars to mixer, while nearly all cement of Atlantic division handled through storehouse. Year's operations show difference in favor of Pedro Miguel Locks of $1.7340 in cost of cement, stone, and sand, and large rock; costs at this locality also lower for forms, placing, pumping, power, repairs, plant arbitrary, and in division expenses, while difference exists in favor of Gatun Locks in mixing and reinforcement. Construction plant at Pedro Miguel in operation from July 15 to Feb. 1, and comparison of costs for 6 months' period, Aug. to Jan., with costs at Gatun Locks for year shows less cost for all items than in Atlantic division except for reinforcement. Noted that mixing by construction plant at Pedro Miguel was $0.1334 and at Gatun $0.1749 per c. y. of concrete. Work at Miraflores done with auxiliary plant to advance work at this locality, and not comparable with construction plant. Auxiliary plant at Gatun mixed concrete cheaper than auxiliary plant at Pedro Miguel, due to local conditions, which require constant train service for supplying material at latter place. By use of large rock in Atlantic division, of which 73,609 c. y. were placed, a net saving per c. y. of material laid during year of $0.2888 secured.

In production of stone, cost in storage bins at Gatun $2.3403, in storage piles for locks on Pacific side $0.8443 per c. y. Crushed stone from Porto Bello is transported to Gatun in barges and unloaded by cableways and derricks, while crushed rock from Ancon is transported from quarry by rail to storage and dumped from trestles. There is, therefore, an extra expense attached to Porto Bello, represented by difference between cost of towing and unloading and that of transporting by rail, of $0.7184 per c. y. If this be deducted from actual cost in storage, it leaves a cost of $1.6219 per c. y. for Porto Bello stone as against $0.8443 for Ancon stone for similar items in cost of stone produced at the two places. This is in a measure explained by harder quality of rock, by method of quarrying, and layout of plant at Porto Bello. Noted that cost of production on 8-hour day basis as compared with 12-hour day basis is less for former, both at Porto Bello and at Ancon.

Sand produced at Nombre de Dios at cost of $0.8795 per c. y. before transportation, or $1.8565 in storage at Gatun. Pacific division secured sand at Chame at cost of $0.1788 per c. y.; cost in storage, $0.8284 per c. y. In both divisions sand was transported by water to point of unloading; 40 miles on Atlantic side and 20 miles on Pacific side. Atlantic division used cableways and cranes to unload, while Pacific division used electric cranes. Omitting cost of transportation from sand bank to docks, cost to Atlantic division was $1.3142 and to Pacific division $0.6015. Less cost secured in Atlantic division when 18" pipe-line dredge was placed in operation at Nombre de Dios.

In connection with division costs, noted that amounts paid for salaries of clerks and supervisory forces, amounted to 26.05 per cent for Atlantic division, 17.8 per cent for Central division, and 22.95 per cent for Pacific division.

Effective July 1, 1910, reports of performance of various parts of plant kept and reported, to secure some data relative to operation of plants. **P-11,** 38–41.

1912. In addition to those reported a year ago, cost accounts prepared and kept for aids to navigation, terminal facilities at Balboa, fortifications, and installation of lock-operating machinery. Supervision of cost data for construction of the docks at Cristobal and New Washington Hotel at Colon added to duties of office; cost of pieces of work in charge of Panama R. R. not included in this report.

In distribution of general expenses Central division continues to carry larger proportion.

Excavation in prism by steam shovels cheapest in Central division, averaging $0.5101; in Atlantic division lower cost is shown than during previous year—$0.5952 against $0.6010—while in Pacific division it is higher—$0.7527 against $0.6960—and also greater than in Atlantic division. In preparation of foundations, costs higher in Atlantic division than year ago and lower in Pacific division, while those of Atlantic division higher than in Pacific division.

In dredging, costs higher than for previous year, and for work in channels Pacific division shows lower than Atlantic division; Pacific division dredging does not include any arbitrary for plant, total cost of which was absorbed prior to fiscal year, but on this side increase in depth attended with additional expense because of great tidal variations.

Total of 1,443,579 c. y. masonry laid in locks and spillways during year, as against 1,741,908 c. y. during previous year. Unit costs for masonry were: Gatun Locks, $7.7552; Gatun Spillway, $7.0988; Pedro Miguel Locks, $6.4640; Miraflores Locks, $4.7675. With decrease in quantity laid of 512,315 c. y. in Gatun Locks, cost of plain concrete last year shows increase of $0.5398 as compared with previous year. At Pedro Miguel, with decrease in amount laid of 363,609 c. y., there was increase in cost of $1.0143, due to forms, placing, mixing, and plant arbitrary, the construction plant having been removed to Miraflores, with exception of two berm cranes, operated until Dec. 12, 1911, and Feb. 7, 1912, respectively. With increase of 456,163 c. y., cost of plain concrete at Miraflores shows decrease of $0.0959. Labor costs for year per c. y. of plain concrete at various locks and spillways show lowest at Miraflores, $0.8394; next, Gatun Locks, $1.3840; Pedro Miguel Locks, $1.4733; and Gatun Spillway, $1.5425.

Difference between costs in Atlantic and Pacific divisions mainly in cost of cement, sand, and stone. While cement for Atlantic division now handled in bags, it must pass through cement shed, while bulk of cement in Pacific division passes directly from cars to work. In production of stone cost in storage bins at Gatun $2.4952, while in storage pile for locks on Pacific side it was $0.7996 per c. y., a difference of $1.6956. If there be deducted from this difference extra expense attached to Porto Bello stone represented by difference between costs of towing and unloading and that of transportation by rail, $0.7365 per c. y., and difference in plant arbitraries, $0.4336, net difference in labor cost in favor of Ancon quarry is $0.5255 per c. y. Sand from Nombre de Dios in stock piles in Atlantic division averaged $2.2414 as against sand in stock piles of Pacific division at $0.7025, or excess of $1.5389 per c. y. in cost of Nombre de Dios sand over that from Chame. Chame sand delivered in stock pile at Gatun cost $1.7079, including $0.7890 for unabsorbed plant charge at Nombre de Dios. Sand secured from Chagres River, May 15 to June 30, cost $1.2850 delivered in stock pile, including $0.7671 for plant.

Cost of concrete piling at Gatun $0.0679 less during year than in 1911, while cost in place $0.7088 less. Total amount driven, 83,670 lineal feet, at cost of $1.5719 per lineal foot; in addition, 51,450 lineal feet wooden piles driven, at cost of $0.6516 per lineal foot. On this basis had wooden piling only been used for south approach pier saving of $77,001.50 would have resulted. In Pacific division 6,580 lineal feet of wooden piling driven for foundations of northeast wing wall, at cost of $2.3200 per lineal foot.

In connection with division costs, to be noted that amounts paid for salaries of clerks and supervisory forces in the three construction divisions less in Central and Pacific divisions during 1912 than during fiscal year 1911, while in Atlantic division percentage higher. Percentages as follows: Atlantic division, 26.09; Central division, 17.39; Pacific division, 18.94. **P-12,** 48–50.

1913. In addition to those reported a year ago, cost accounts initiated for erection of permanent buildings, construction of electric transmission line across Isthmus, and preparation of permanent town sites. Cost accounts of first division, which include erection of lock gates, emergency dams, lock-operating machinery, and aids to navigation, revised so as to furnish better information.

Supervision of cost data for construction of concrete dock at Gatun and of bridge across French canal at Mount Hope to connect with site of Cristobal coaling plant added to duties of the office. These projects, as well as construction of dock at Cristobal and of New Washington Hotel at Colon, in charge of Panama R. R. Co., and their costs not included in this report. Oct. 1 preparation of detailed costs for aids to navigation transferred to this office; on Jan. 1 that for reorganized divisions of former Pacific division and for first division of O. C. E.; and on Apr. 1 that for Atlantic division. Although details of costs have greatly increased in past year, expense of securing data decreased from about $3,600 per month to $3,000 per month.

In distribution of general expenses, Central division continues to carry larger proportion.

Excavation by steam shovels in Central division shows increased cost over last year of $0.0410, principal item of increase being in cost of repairs to equipment—$0.0297.

In Atlantic division costs for dredging in prism lower this year than last, due to larger ratio of material excavated by pipe-line suction dredges. In Pacific division cost higher than last year, due to larger ratio of rock excavation and increased depth, which is attended with additional expense because of great tidal variations.

Hydraulic excavation in channel below Miraflores Locks concluded Nov., 1912, and plant reerected at point north of Gold Hill to sluice top banks to relieve pressure. Operations began June 16, and to close of year 57,274 c. y. material had been removed, at division cost of $0.1835 per c. y., including arbitrary of $0.1000 per c. y. for plant. Work being performed by fifth division, O. C. E.

Total of 771,907 c. y. of masonry laid in locks and spillways, as against 1,443,570 c. y. during previous year. This is inclusive of masonry laid by first division in connection with installation of operating machinery. Costs per c. y. for masonry were: Gatun Locks, $7.2794; Gatun Spillway, $8.1227; Gatun power house, $8.5739; Pedro Miguel Dam, $5.0240; Pedro Miguel Locks, $7.5976; Miraflores West Dam, $4.3330; Miraflores Spillway, $5.8497; Miraflores Locks, $5.6445. Plain concrete shows increased cost over last year in all projects, except Gatun Locks, due to reduced quantities of concrete laid and to use of larger ratio of auxiliary mixers. At Gatun Locks plain concrete shows decrease of $0.5934, principally in cost of sand and stone, in expense for steel forms, and in arbitrary for plant, decrease in cost of sand and stone being due to readjustment of stock prices (revised cross-section measurement of the stock piles having shown more stone in storage than was carried on books), and securing sand from borrow pit at Gatun instead of from Nombre de Dios. At Miraflores Locks plain concrete shows increase of $0.4406 per c. y., principally in cement, mixing, wood forms, and placing. Fluctuations in cost of reinforced concrete due to different classes of reinforced concrete laid during the two years.

Dam at Gatun increased by 1,714,367 c. y. of dry fill at division cost of $0.3755 per c. y., and 169,114 c. y. of hydraulic fill at division cost of $0.2654 per c. y. At close of year there were in place at Gatun Dam 11,578,268 c. y. of dry fill at cost of $0.4063 per c. y., and 10,124,082 c. y. of hydraulic fill at cost of $0.2933 per c. y.

During 1913 no filling for Colon Breakwater secured from Toro Point; 183,762 c. y. large rock secured from Porto Bello quarry placed in breakwater at average division cost of $4.8250 per c. y. Last year 65,133 c. y. rock placed in breakwater at division cost of $4.3064 per c. y.

Ancon quarry alone operated during fiscal year and produced 688,301 c. y. crushed stone at average cost of $0.7795 delivered in storage. To close of year quarry had produced 2,558,578 c. y. crushed rock at average cost of $0.8572 per c. y. delivered in storage. Porto Bello quarry began operations Mar., 1909, and closed down Apr., 1912; produced 1,921,929 c. y. crushed rock at average cost of $2.4337 per c. y. delivered in storage. There was secured from Chame sand pit 445,658 c. y. of sand at average cost of $0.7111 per c. y. delivered in storage. To end of year there was secured from this source 1,741,196 c. y. of sand at average cost of $0.7666 per c. y. From pit at Nombre de Dios on Atlantic side, opened Mar., 1909, and closed Nov., 1911, there was secured 785,893 c. y. of sand at average division cost of $1.9176 per c. y. delivered in storage. During year there were secured from borrow pit near Gatun Dam 43,851 c. y. of sand at average cost of $0.5188 per c. y.

To close of year following amounts had been expended: On spillway gates and caissons, at Gatun, $73,732.22; at Miraflores, $40,625.69. On spillway gate machines and their erection, at Gatun, $91,122.95; at Miraflores, $64,299.22. On lock gates and their erection, at Gatun, $2,225,084.30; at Pedro Miguel, $1,373,537.13; at Miraflores, $1,233,845.37. On fender chains, at Gatun, $3,836.95; at Pedro Miguel, $21.37. On emergency dams, at Gatun, $816,184.77; at Pedro Miguel, $512,480.47; at Miraflores, $38,803.75. On lock-operating machinery, including towing-track system, concrete used in the installation of machines, etc., at Gatun, $2,592,232.64; at Pedro Miguel, $1,361,873.92; at Miraflores, $1,561,817.40. For towing-track system following number of linear feet of return track laid by construction divisions at various locks: Gatun, 10,527, average division cost $1.3261; Pedro Miguel, 4,333, average division cost $1.1065; Miraflores, 5,925, average division cost $2.5637; and by first division at Gatun, 1,449, average division cost $1.9273; at Pedro Miguel, 2,043, average division cost $2.3678; at Miraflores, 1,082, average division cost $0.6085 per linear foot. Linear feet of track, with rack installed by first division, and average cost per linear foot were: At Gatun, 21,000, average division cost $2.3128; at Pedro Miguel, 12,199, average division cost $2.0180; at Miraflores, 14,137, average division cost $1.2291.

In connection with erection of operating machinery, installation of towing tracks, and decking, first division had laid to June 30, 1913, 36,710 c. y. of concrete, as follows: At Gatun Locks, 16,706 c. y., average division cost $13.4124 per c. y.; at Pedro Miguel Locks, 10,190 c. y., average division cost $12.1460 per c. y.; at Miraflores Locks, 9,814 c. y., average division cost $11.3013 per c. y.

Total expenditures for aids to navigation to close of year, $377,041.63.

For Cristobal terminals $14,488.14 expended, and for terminal facilities at Balboa, $1,943,971.09. There had been excavated in preparation of site 412,707 c. y. at average cost of $0.5620 per c. y. In filling, 505,419 c. y. used at average cost of $0.3992 per c. y. Dredged in preparation of inner harbor at latter point 1,771,814 c. y. at average cost of $0.1547 per c. y. For main dry dock excavated 145,478 c. y., and for coaling station 58,221 c. y., at average cost of $0.8461 per c. y. In preparing foundations for shops 29,684 c. y. had been removed at average cost of $1.5607 per c. y.; 7,787 c. y. concrete placed at average cost of $9.2091 per c. y., 135,442 linear feet of wood piles and 3,060 linear feet of concrete piles driven, at average cost of $0.4820 and $3.2358 per linear foot, respectively. In constructing docks 12,435 linear feet of concrete caissons placed at average cost, including excavation, of $18.4708 per linear foot.

Expended in preparation of permanent town sites $52,458.77 and in construction of permanent buildings $55,918.76. In preparation of foundations for administration building 38,073 c. y. excavated, at average cost of $0.5654 per c. y., and 770 c. y. of concrete laid in foundation sat average cost of $12.8646 per c. y.

Amount paid for salaries of clerks and supervisory forces during year 19.75 per cent of total amount disbursed for salaries. Last year it was 20.55 per cent, indicating saving in clerical and supervisory forces of $185,000. **P-13,** 49–53.

Cost keeping formerly done by various divisions of work gradually consolidated under chief accountant, so that at close of year he had charge of all work of this character, with exception of that of Central and Mechanical divisions. **P-13,** 2.

1914. Oct. 1, 1913, time keeping and cost keeping for the Central division and cost keeping for Quartermaster's department transferred to O. C. E. and consolidated with forces already organized under this office to take care of time keeping and cost keeping of other branches of the work. **P-14,** 2.

In addition to those reported last year, cost accounts initiated for Cristobal coaling plant, gravel-reclaiming plant at Balboa, and construction of permanent concrete buildings. In addition to duties enumerated in last annual report, cost accounting for work under jurisdiction of former Central division and that for Quartermaster's department transferred to this office Oct. 1, 1913, and on June 1, 1914, that of Electrical division. Cost-keeping accountant has been engaged preparing permanent accounting systems for operation and maintenance of canal since Apr. 1, and to close of year most of this work completed with exception of minor detailed accounts, which will be initiated as the necessity develops. At close of last year pay roll of office about $3,000 per month, and there were transferred with accounts of former Central division and of Quartermaster's department employees whose salaries aggregated $975 per month; pay roll at close of year about $3,600 per month. This, notwithstanding increase in accounting work for terminals, town site, permanent buildings, and Electrical division, which exceeded by far decrease on account of completion of some of canal units.

General expenses prorated to construction work this year amount to 11.12 per cent of division cost and for period to date to 8.73 per cent.

Comparative costs not given this year for all units of construction, as conditions due to completion of work make such comparisons valueless. At Ancon rock quarry there was decrease of 185,503 c. y. in quantity of crushed stone produced and increase of $0.1179 per c. y., principally in operation of and repairs to crushers.

Sand dredged from Chame Point decreased 246,339 c. y. and cost increased $0.1154 per c. y., principally in expense of dredging and towing to Balboa.

Cost of large rock in place in Colon west breakwater increased $0.4480 per c. y. as compared with last year, due to increase in charge for plant arbitrary, made necessary by decreased quantity of rock placed in breakwater as compared with estimate.

There was increase of $0.3154 per c. y. in cost of rock placed in Naos Island breakwater, due to charging this account with expense of quarrying and transporting rock from Sosa Hill and of transporting rock secured from excavation in area of dry dock at Balboa.

To end of year total of $440,483.46 expended—for terminal facilities at Cristobal, $390,789.31 for coaling plant and $49,694.15 for fuel-oil storage plant. For terminal facilities, Balboa, total of $6,665,446.24 expended—$1,108,773.31 for surveys and in preparation of site, $592,971.66 in dredging inner harbor, $504,320.59 in construction of main dry dock, $78,312.02 in construction of small dry dock, known as Dry Dock No. 2, $287,269.17 in construction of coaling plant, $386,004.07 in excavating entrance basin, $126.85 in construction of sea wall, $2,444,462.23 in construction of perma-

nent shops, storehouses, and roundhouse; $1,212,917.01 in construction of docks, and $50,289.33 in construction of fuel-oil plant and in dredging berth for oil ships.
In preparation of permanent town sites $132,539.23 expended for La Boca, $409,116.35 for Balboa, and $112,349.25 for Pedro Miguel; total of $654,004.83.
In construction of permanent concrete buildings, $716,936.09 expended for administration building at Balbóa, $425,210.17 for 28 four-family apartment houses, and $20,737.76 for 9 two-family apartment houses.
Administrative and general expenses increased $292,404.07. Of this amount about $120,000 is apparent only and is due to consolidating time and cost-keeping forces in executive office, expense having previously been borne by construction divisions. Remainder is due principally to heavy charges for repatriation of employees leaving service or discharged for reduction of force, and to expense of moving storehouses at Gorgona and Empire. **P-14,** 50–52.

Cost of Canal. (See No. 248, p. 2367 of this Index.)
Revised estimate of the cost of the proposed canal submitted at a hearing before the Committee on Appropriations of the House of Representatives in Feb., 1909. 50 per cent more work necessary in order to complete the canal than was contemplated by the original estimate. Unit prices, due to labor conditions, cost of materials, and gratuities given employees, have been increased 20 per cent. New estimate shows total cost of engineering and construction as summing up $297,766,000, to which, if the purchase price and the estimated cost of sanitation and civil government be added, there results the sum of $375,201,000 as the total cost of the canal. Isthmian Canal Commission No. 1 estimated $144,233,358, 1899–1901, including sanitation and police. Minority report of the Board of Consulting Engineers, 1906, fixed the cost for engineering and construction, exclusive of the purchase price, the cost of sanitation and civil government and the interest, at $139,705,200. **P-09,** 31.

Costs. (See Nos. 243, 248, 250, 272, p. 2367, 2368 of this Index.)
Tables are in each annual report showing costs of excavation, foundations, spillway, locks, prism, dredging, masonry, fill, levee, breakwater, concrete work, piling, stone, sand, lighting, buoying, quarries, cableways, derricks, mixers, plant, cranes, unloading, etc.
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Administration and general expenses, **P-14,** 455.
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Labor, **P-05,** 46.

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Panama R. R. cases, **P-13,** 520, 523.
Procedures, **P-05,** 96.
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View of first U. S. court held on zone, Ancon, **P-05,** 68.

Courts (1905).
Judicial authority in zone vested in 5 municipal courts, 3 circuit courts, and a supreme court. Difficulty of obtaining judges speaking English and Spanish. 2,373 cases tried in year ending Oct. 31, 1905, and 358 civil cases tried. Contemplated in organizing the circuit courts they could be utilized as land courts. Property titles on Isthmus uncertain. Court system may make titles more certain. **P-05,** 67.
Court procedure: Provisional rules and regulations; supreme court; circuit court; municipal courts; appeals; new trial; civil actions; commencement of action; summons; answer, demurrer; further pleading; upon agreement of facts; taking of testimony; witnesses; depositions; appeals; special proceedings; briefs and arguments; judgment; execution; attorneys at law; dockets of supreme and circuit courts; estates of deceased persons; history of a civil cause; criminal cause; fee bill; meeting of circuit courts. **P-05,** 96.

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- Reductions in force, **P-11**, 226.

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- Unloading sand, Balboa, **P-10**, 196, pl. 52, 116.

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- Miraflores, **P-10**, 164.
- Pedro Miguel, **P-10**, 162.
- Performances, Miraflores, **P-11**, 165; **P-12**, 177; **P-13**, 168.
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- "Ajax" and "Hercules," **P-14**, pl. 119, 120.
- Equipment, **P-14**, 180.
- General description, **P-13**, 213.
- Terminals, **P-13**, 209.

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- Pedro Miguel Lock, **P-10**, 196, pl. 44.

Cranes, Wrecking, P-07, pl. 27.

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Crest Gates. (See Gates, crest.)

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- Statistics, **P-05**, 95, Table 30; **P-07**, 172; **P-08**, 270. (See Civil administration.)

Cristobal. (See Nos. 35, 156, pp. 2362, 2364 of this Index.)

Crossings. (**See Panama R. R.**)

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- Turnouts and, locks, **P-14**, 109.
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- Borings, Gatun Dam, **P-08**, 196, pl. 158–164.
- Chagres River gauging stations, **P-12**, 104; **P-13**, pl. 120.
- Gatun Dam studies, **P-08**, 196, pl. 133.
- Experimental dam, Gatun, **P-08**, 196, pl. 139.
- Embankments, Panama R. R., **P-11**, pl. 118.
- Lock canal, **P-06***, 7.
- Sea-level canal, **P-06***, 7.
- Typical cross sections adopted for Culebra Cut by Board of Consulting Engineers, **P-06***, 134.

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- Ancon quarry, **P-10**, 195; **P-11**, 189; **P-12**, 202; **P-13**, 184.
- Bas Obispo, **P-07**, 74.
- Pedro Miguel, **P-07**, 67.
- Performances, **P-11**, 290; **P-12**, 307; **P-13**, 286.
- Plant layout, Ancon, **P-09**, 134, pl. 58.
- Porto Bello, **P-09**, 66, pl. 23.
- Rio Grande, **P-09**, 69.

Culebra Cut. (See Excavation; Slides; see No. 223, p. 2366 of this Index.)
- 1,000,000 c. y. removed. 2,600 men. **P-05**, 12.
- No systematic work can be done here until sea-level or lock plan has been chosen. Each plan requires different method of attacking the cut. **P-05**, 15.
- Status, Aug., 1905. Estimated by Mr. Wallace that cost of excavation would be 50 cents c. y. This estimate probably instrumental somewhat in requiring a consideration of the advantages or practicability of a sea-level canal by Isthmian Canal Commission No. 2. Estimate not conclusive, as later excavating would undoubtedly be comparatively expensive. **P-05**, 144.
- Excavation: Graphical illustration of practicable yearly excavation which would complete the Culebra Cut in less than 10 years, **P-06***, 7.
- Memorandum by Mr. John F. Wallace, to accompany diagrams illustrating tentative method of Culebra excavation, **P-06***, 372–374.
- Diagram 1 is an average maximum cross section, and shows in numbers and colors the different phases of steam shovel progress. Diagram 2 shows the A and B sections at kilometer 54.74 on the line of the maximum cross section above elevation 185 with the different phases in colors and numbers. Diagram 3 is a progress diagram showing the relative positions, horizontally, of the different steam shovels which may be installed at elevation 185 and below. It also shows the time of entering and the completion of each phase of the work. Diagrams 4 to 7, inclusive, are diagrams showing a suggested arrangement of tracks and shovels covering the first 5 phases of the work below elevation 185. **P-06***, 372, 373.

Culebra Cut, Views of. (Arranged in order of time.)
- View from reservoir, Plate 1, **P-07**, 8; **P-08**, 56, pls., 2, 3, 4, 5, 6.
- Between Empire and White House yard, June, 1909, **P-09**, 90, pl. 29.
- Looking toward Gold Hill, **P-09**, 90, pl. 30.
- Near Paraiso, June, 1909, **P-09**, 90, pl. 31.
- Las Cascadas, June, 1909, **P-09**, 90, pl. 32.
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Opposite Cucaracha slide, June, 1909, **P-09**, 90, pl. 34.

View of cut, vicinity of Contractors Hill, **P-10**, 160, pl. 22.

View of cut, opposite town of Culebra, after heavy rain, **P-10**, 160, pl. 23.

Empire to Las Cascadas, view of cut, **P-10**, 160, pl. 25.

Bas Obispo, view of cut, **P-10**, 160, pl. 26.

West wall, break, **P-10**, 160, pl. 35, 36, 37.

East bank, breaks, **P-10**, 160, pl. 39.

Cunette angle, north of Empire, **P-11**, 156, pl. 27.

Opposite Paraiso and just north of Panama R. R. bridge 57½, **P-11**, 156, pl. 28.

Opposite Las Cascadas, **P-11**, 156, pl. 29.

At Empire suspension bridge, **P-11**, 156, pl. 30.

Looking north between Contractors Hill and Gold Hill, **P-11**, 156, pl. 31.

South end, looking south from bridge 57½, and showing the partly completed anchorage basin north of Pedro Miguel Lock. Train shown on completed bottom of canal, elevation plus 40. **P-12**, 170, pl. 28.

Looking north from bridge 57½, near Paraiso. Train shown on completed bottom of canal, plus 40. **P-12**, 170, pl. 29.

Looking north from a point south of Contractors Hill, showing quiescent state of Cucaracha slide on right bank. Bottom of lowest steam-shovel cut about 16′ above the final bottom of the canal, or elevation plus 56. **P-12**, 170, pl. 30.

Looking south from Empire suspension bridge. Well drills shown in middle of canal about 27′ above the bottom, or at elevation plus 67. **P-12**, 170, pl. 32.

Looking north from Empire suspension bridge. Nearest shovel shown, in the lowest cut, is working about 12′ above the bottom, or at elevation plus 52. **P-12**, 170, pl. 33.

Looking south from Cunette. Two shovels shown are working at bottom of canal, elevation plus 40. **P-12**, 170, pl. 34.

Looking north from Cunette. Two shovels shown are working at bottom, elevation plus 40. Water in center drainage channel is about 6′ below bottom, elevation plus 34. **P-12**, 170, pl. 35.

Looking north from Las Cascadas. Trains standing in the bottom of the cut, elevation plus 40. **P-12**, 170, pl. 36.

Looking south from bend in east bank near Gamboa. Train and shovel shown are on bottom of the cut. Water in drainage channel is about 10′ below bottom of the canal, or at elevation plus 30. **P-12**, 170, pl. 37.

Break in east bank of canal. Amount of material involved, 320,000 c. y. Train shown about 35′ above bottom of the canal, or at elevation plus 75. **P-12**, 170, pl. 41.

Bas Obispo. Looking south from east bank, June, 1913. **P-13**, 160, pl. 34.

Completion of bottom pioneer cut, steam shovels Nos. 230 and 222 meeting at grade, looking north from west bank. May 20, 1913. **P-13**, 160, pl. 35.

Looking north from one-quarter mile south of suspension bridge at Empire. Cut completed at bridge. All tracks on completed bottom of canal. June 16, 1913. **P-13**, 160, pl. 36.

Empire. Looking north from suspension bridge, showing cut completed, except toe of slide on right. Drainage ditch is below bottom of canal. June 16, 1913. **P-13**, 160, pl. 37.

Empire. Looking south from suspension bridge, showing terracing on upper levels of east bank to prevent slides. Lower shovels are working on bottom of canal. June 16, 1913. **P-13**, 160, pl. 38.

Culebra. Deepest excavated portion of Panama Canal, showing Gold Hill on the right and Contractors Hill on the left. June, 1913. **P-13**, 160, pl. 39.

Las Cascadas. Looking north from east bank. June, 1913. **P-13**, 160, pl. 40.

Empire. Break in east bank at La Pita (station 1651), taking in Obispo diversion channel, looking north. Aug. 21, 1912. **P-13**, 160, pl. 41.

Culebra. Break in east bank between stations 1746–1758. Steam shovel No. 201 in midst of upheaved material and displaced tracks, looking south. Feb. 6, 1913. **P-13**, 160, pl. 42.

Culebra. Break in east bank between stations 1746–1758. Top view of rear portion of slide, looking north. Feb. 6, 1913. **P-13**, 160, pl. 43.

Culebra. Bottom of canal, steam shovel No. 260 overturned by slide from east slope. June 12, 1913. **P-13**, 160, pl. 44.

Culebra. Looking north from west bank, south of Contractors Hill, showing shovel No. 256 caught in Cucaracha slide. Feb. 7, 1913. **P-13**, 160, pl. 45.

Bottom of cut, **P-14**, pl. 41, 43.

Culebra Division, **P-07**, 44; **P-08**, 40. (See No. 139, p. 2364 of this Index.)

Status, **P-05**, 133, 134.

1904. At the time of the first visit of the Isthmian Canal Commission No. 2 the only work in progress was some excavation here. Outfit consisted of a few French excavators (steam) and dump trains, and a force of about 700 men engaged in blasting, loading cars, removing the excavated material from the track and down the slopes of the fill; neither equipment nor organization adequate; deemed advisable, however, to keep the force (already acclimated). **P-04**, 39.

1905. Division extends from Bas Obispo to Miraflores. Since American control, work of experimental character. Equipment poor. Apparently no definite system followed.

Excavation closed down. Reconstruction of equipment begun. Preparatory work in progress. Actual working year probably only 8 or 9 months, because of rainy season. Future plans dependent on whether sea-level or lock canal is to be adopted. Problem at Culebra one of transportation, including disposal, pure and simple. Surveys made of vicinity. Much miscellaneous work, for other departments, as the furnishing of maps, plats, etc. Location of proper dump grounds under way. New offices for engineering department planned to be located at Culebra and Empire instead of Panama. **P-05,** 117.

1906. No special attempt made to get out yardage, but rather to take out barriers left by the French. Equipment trackage completed, and necessary yards and dumping grounds arranged for. 1,500,000 c. y. excavated at 79.5 cents per c. y. Increase in cost over previous year due to harder material, more rainfall, and 8-hour day. At the beginning of the year 10 shovels ready for work; at the close, 39 shovels, 300 western dump cars, 560 40′ flat cars, these being received late in the year. Mining department working at high efficiency. **P-06,** 86.

(See p. 2366 of this Index and Central Division.)

Culverts.
- Auxiliary culvert machines, **P-13,** 88; **P-14,** 104.
- Building, Gatun, **P-08,** 216, pl. 177.
- Center wall culvert, Miraflores, **P-12,** 108, pl. 10.
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- Form, side-wall culvert and laterals, Pacific division, **P-11,** pl. 111.
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- Pedro Miguel Locks, **P-14,** pl. 72, 73.
- Tests, cylindrical and auxiliary culvert machines, **P-13,** 89.
- T form used for equalizing culvert and floor lateral connections, Pacific division locks, **P-11,** pl. 113.
- Transition curve, leading from Stoney gate chamber, Gatun Locks, **P-11,** 132, pl. 17.

Culverts, Floor. (See Culverts.)
- Miraflores Locks, **P-12,** 204, pl. 52.

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- Paper by C. D. Ward, member American Society of Civil Engineers. Reprinted from Transactions of A. S. C. E., Vol. LIII, 1904, p. 36. After mentioning a list of authorities and their pertinent writings on the subject, from 1875 to 1902, Ward says: "Neither of these authorities mentions or gives any consideration to the project of a dam at Gatun, nor even condemns it; nor is the writer aware that any soundings or other examinations, looking to a dam at that point, have ever been made." Drawing. Detailed advantages of a dam at Gatun. Estimate of project, with one lock at Gatun and one at La Boca, each of 45′ lift, $155,111,936. (Estimate made by Isthmian Canal Commission with summit level at 90′, $144,233,358.) "If it should appear that such examinations have not been made, it is hoped that this paper will induce those in authority to make such examinations before deciding upon the final plans for the Panama Canal." P-06*, 279–282.
- Upon considering the various factors of seepage, foundations, etc., Board of Consulting Engineers recommended at Gamboa either an earth dam with a heavy masonry core carried down to bedrock, or an all-masonry structure founded at the same depth and upon the same material, P-06*, 45.

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  1908. Duties: Had charge of time inspection, preparation of pay rolls, vouchers, issuances of commissary and hotel books, and disbursements of moneys on the Isthmus.
  Organization: By Executive order Aug. 15, 1907, time inspection assigned to examiner of accounts; keeping property records and general books of the Isthmian Canal Commission transferred to the disbursing office.
  Methods: Monthly payments instead of semimonthly; preparation and checking of pay rolls in division offices instead of in disbursing office; elimination of duplicate property records in the division of material and supplies.
  Disbursements: Pay rolls, $18,062,000. Average payment per month to employees on gold roll, $125.80. Silver roll, $40 gold, or so. P-08, 29; P-09, 25.

  1910. The work of this department embraces securing, disbursing, and accounting for all funds paid out or collected, and issuance of hotel and commissary books and meal tickets, P-10, 40.

  1911. Pay-car schedule, which formerly provided 4 days to effect payment of forces on Isthmus, reduced to 3 in Apr. Total paid out on pay rolls aggregated $19,415,987.02, in addition to which $10,017,600.13 paid in settlement of public bills and reimbursement vouchers. Value of hotel books, commissary books, and meal tickets issued, $4,150,943.50, P-11, 48.

1912. Total paid on pay rolls, $19,407,398.90; in addition, $10,465,634.09 paid in settlement of public bills and reimbursement vouchers. Hotel books, commissary books, and meal tickets issued $4,591,510.50, **P-12,** 58.
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Dredging Division. (See No. 264, p. 2368 of this Index.)
  1913. When it was finally decided to turn water into Culebra Cut, Oct., 1913, and to complete remaining excavation by dredges, all dredging on Isthmus combined under one head. May 1, 1913, dredging work under Atlantic division transferred to sixth division, O. C. E., consolidating it with dredging organization of Pacific side. Same date drydock shops at Cristobal transferred to mechanical division. P-13, 2.
  1914. Dredging division subdivided into two districts, the first extending from deep water in Pacific to Gamboa, and the second from Gamboa to deep water in Caribbean.
  In first district, Pedro Miguel Locks to sea, 5,364,816 c. y. removed, of which 3,329,072 c. y. taken from within prism. Of amount from prism, 1,186,432 c. y. rock. Of rock excavated, 146,477 c. y. drilled and blasted by drill barge "Teredo" and 60,832 c. y. broken by rock breaker "Vulcan." Operations began in Culebra Cut Oct. 23, 1913, and continued throughout the year; 3,432,363 c. y. removed, of which 919,655 c. y. earth and balance rock. Of this amount, 865,015 c. y. earth and 1,557,360 c. y. rock removed from Cucaracha slide. Pipe-line dredges pumped over west bank into Rio Grande Valley 684,514 c. y. earth and 77,880 c. y. rock. Cucaracha slide very active since dredging operations, daily movement averaging 2¼'. June 30, 1914, area of slide 60.4 acres, 44.6 acres active and 15.8 acres without motion. Dredging done during 4 months of year in Miraflores Lake, removing 159,817 c. y. earth from prism.
  In second district 6,544,192 c. y. removed—5,692,576 c. y. from within prism, 574,630 c. y. from old French dump in Limon Bay; 158,994 c. y. from prism were rock. Of total taken out, there were removed between Oct., 1913, and Feb., 1914, 507,195 c. y. earth and 5,035 c. y. rock from canal prism north of Gamboa, formerly known as Point No. 1.
  In connection with Atlantic terminals, dredges removed 18,286 c. y. earth and 16,015 c. y. rock from site of bridge crossing French canal south of drydock, 117,289 c. y. earth from approach channel, 275,993 c. y. earth and 46,360 c. y. rock from new Piers Nos. 7, 8, and 9, and 181,709 c. y. earth and 213,325 c. y. rock from coaling station. 17,000 c. y. placed in fill for substation and 304,411 c. y. placed in fills for bridge foundations, coal basins, and yards at coaling station.
  At Pacific terminals dredges removed 1,919,003 c. y. earth and 7,964 c. y. rock, of which 1,831,711 c. y. earth handled by pipe-line dredges and placed in fills for reclaiming swamp land.
  Considerable amount of miscellaneous dredging done, making total removed by dredging fleet, including sand and gravel reclaimed, 15,341,371 c. y. The fleet consisted of seagoing suction dredges "Caribbean" and "Culebra," seagoing ladder dredge "Corozal," French ladder dredges "Badger," "No. 1," "No. 5," "Gopher," "Marmot," and "Mole" (the last abandoned as worn out on Sept. 20, 1913), 5-yard dipper dredges "Cardenas," "Chagres," and "Mindi," 15-yard dipper dredges "Gamboa" and "Paraiso," and pipe-line suction dredges "No. 4," "No. 82," "No. 83," "No. 85," "No. 86," and "Sandpiper." In connection with these there were employed 12 tugs, 19 launches, 9 clapets, and 24 dump scows.
  As noted in last report, contract made with Bucyrus Co. for two 15-yard dipper dredges.

First ready for towing to Isthmus Dec. 1, 1913, and second Jan. 1, 1914. First accepted at Port Richmond, N. Y., Feb. 16, reached Isthmus Mar. 16, and placed in operation Apr. 4, 1914. Second accepted at Port Richmond Apr. 13, reached Isthmus May 22, and went into commission at Cucaracha slide June 7, 1914. Buckets not sufficiently strong, and additional delay caused. Failure to meet dates of delivery resulted in handicapping work at Cucaracha slide and delayed securing channel sufficiently deep and wide to permit canal to be utilized for passage of commerce before close of year.
$2,000 authorized for temporary dikes on west side of channel where it is cut through at head of Limon Bay, to determine effect upon erosion occurring, due to waves created by trade winds. Results so satisfactory that it was decided to make dikes permanent. P-14, 31-33.

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Electrical Division.
- 1914. Operation of various power plants consolidated Apr. 1 to comprise electrical division, under Capt. W. H. Rose, U. S. Army. Includes operation and maintenance of steam-driven electric power plants at Gatun, Miraflores, Empire, and Balboa, and all substations, transmission, and distribution lines connected with power plants; operation and maintenance of air-compressor plants at Empire and Balboa; construction, operation, and maintenance of building and street lighting systems in zone; operation and maintenance of electric cargo-handling cranes on Panama R. R. pier at Balboa; installation of electrical equipment of new Balboa shops of mechanical division; and construction of permanent underground conduit systems for permanent towns of zone.
- One of three 1,500-kilowatt vertical turbogenerator sets and two 410 high-pressure water-tube boilers removed from Gatun station for installation at Miraflores power plant. New unit in place June 1, 1914; gives Miraflores plant capacity of about 6,000 kilowatts, same as hydroelectric station. Total power in kilowatt hours generated during year: 6,824,556 kilowatt hours at Gatun, at $0.0175 per kilowatt hour; 16,352,732 kw. h., Miraflores, at $0.0135 kw. h.; 2,327,877 kw. h., Empire, at $0.0240 kw. h.; 138,143 kw. h., Balboa, at $0.1503 kw. h.
- Air-compressor plants operated during year at Empire and Balboa, and Rio Grande plant operated until Nov. 1, 1913; furnished compressed air for excavation work at Culebra, Rio Grande, and Gold Hill; for mechanical division shops at Empire, Balboa, and Paraiso; for division of erection at Pedro Miguel Locks, Ancon quarry, and for work in vicinity of Sosa Hill and new dry dock at Balboa.
- Removal and reerection of wooden buildings from various points along line to Ancon-Balboa district necessitated removal of wires and fixtures, and later rewiring, of 178 buildings. Feb., 1914, two temporary substations completed, one at Miraflores and one at Balboa, each of 1,500-kilowatt capacity, for 11,000-volt transmission between these points. May, 1914, another 11,000-volt transmission line completed between Miraflores power plant and Cucaracha, supplying power to relay pumps and Gold Hill hydraulic plant. Additions and alterations necessitated change in pole lines for construction, amounting to 15 miles. 25 miles pole line to supply power to range lights and beacons of lighthouse subdivision constructed, lighthouse subdivision erecting poles and electrical division installing wires and transformers and making connections to lights and beacons. Duplicate 2,200-volt armored cables, supplying power to Agua Clara pumping station, installed between that station and Gatun substation. In all, 12,900′ conduit, having 83,000′ of duct incased in concrete, and 40 concrete manholes completed during year between Pedro Miguel telephone exchange, Tivoli Hotel, new administration building at Balboa, and latter with Balboa substation. Large amount of conduit work done in connection with electrical work in permanent buildings and Balboa shops. Eight 4-ton alternating current cargo-handling cranes, five 4-ton direct-current cranes, and one 20-ton direct-current French crane, all on Panama R. R. pier at Balboa, operated and maintained. These cranes handled practically all commercial freight crossing Isthmus in either direction. Vessels loaded and unloaded, 413. P-14, 22, 23.

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2,175 buildings inherited from French in bad condition. 2,400 men engaged in destroying buildings, repairing others, and erecting new ones. Hotels under construction. **P-05,** 7.
Nov., 1904, 3,500 employees on the Isthmus. In Nov., 1905, 17,000. White Americans, 1,500. Panama R. R. employed about 2,500, not included above. **P-05,** 9.
Nov. 15, 1904, the President put all employments, except laboring, under civil service

rules and regulations. Difficulty of obtaining skilled employees due to prosperity in the U. S. and sensational stories about health on the Isthmus. P-05, 10, 11.
Number of employees approximately 17,000. Efforts to provide social environment, clubs, lodges, churches, etc. 8-hour day adopted May 10, 1905, for laborers and mechanics. Pay of 10-hour men increased. Only minor complaints at times from employees. P-05, 56.
Inexpensive method of administering estates of employees provided. 23 estates cared for. P-05, 66.
Credit given American employees who stayed on the Isthmus in the face of the yellow-fever panic, P-05, 73.
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Efficiency of staff might have been better if more discretion had been exercised in selections and appointments, P-05, 109.
Some difficulty in getting men from the U. S. Wild newspaper reports somewhat responsible. P-05, 120.
Policy of the Isthmian Canal Commission has produced a personnel entirely capable of good results, P-05, 120.
Force inadequate. 5,000 additional men needed, Aug., 1905, at Culebra alone. No adequate facilities for housing men. P-05, 145.
Sufficient buildings to house all its bachelor employees. 335 separate houses and 13 larger buildings constructed for married quarters, providing accommodations for 375 families. Approximately 1,200 American women and children on the Isthmus. P-06, 3.
4,869 persons tendered employment in the U. S. for Isthmus work; 3,962 accepted; 3,243 transported to their work. 834 members of families of employees and 929 persons returning from leave of absence have been transported at reduced rate. Capacity of Panama R. R. boats exhausted at times; other lines had to be used. Employees secured through the Civil Service Commission, employment agents, or personal application. On Jan. 12, 1906, the President put all employments on the Isthmus outside civil service examination, except clerks, bookkeepers, stenographers, typewriters, surgeons, physicians, internes, trained nurses, draftsmen. P-06, 6, 7.

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Engineering and Construction. (See No. 40, p. 2362 of this Index.)
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Begun with four parties, each in charge of a resident engineer; preliminary work begun early part of 1904 immediately after return of Isthmian Canal Commission No. 2 from Isthmus. The first party sailed from New York about the middle of May, 1904. The chief engineer, John F. Wallace, entered upon his duties June 1, 1904. Early work surveys, etc.; study of water-supply question, control of the Chagres, terminals, etc. Operations at Culebra were continued with force of about 700 men. Plant taken over was cared for and examined. When the chief engineer arrived, force was entirely reorganized, plant was overhauled, accounting system established. P-04, 48.

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1905. Stopped by Isthmian Canal Commission No. 3 until preparatory work of sanitation, quarter providing, terminal construction, etc., had been adequately arranged, **P-05**, 6.
Estimate of rate of. "Demonstrated that each steam shovel may be counted upon to yield an average record of at least 1,000 c. y. per working day. The chief engineer estimates that with 100 steam shovels installed, with a complete system of tracks serving them, a yearly record of 30,000,000 c. y. of excavation may be reached without requiring a greater output per shovel or greater speed in working than has already been attained. This rate of working could probably be reached within two years from the present time." **P-05**, 299.

1906. Engineering work hitherto considered preparatory. Delay in deciding upon type of canal made it impracticable to locate permanent and well-arranged dumping grounds. Levels at Culebra Cut put in proper condition for installation of a maximum number of steam shovels, etc. 1,500,000 c. y. excavated during the year, as against 742,000 c. y. previously. Notwithstanding rainy season (Apr.–Dec.), 244,844 c. y. taken from Culebra, the largest amount taken out up to that time during any one month since the canal came under American control. "At the close of the fiscal year, which was practically the date of the decision, as to the type of canal, the conditions in Culebra Cut regarding the installation of shovels and consequent large increase in the output, were generally satisfactory. At the beginning of the fiscal year there were 10 shovels erected and ready for work. There was available in Sept., 1906, a a total force of 46 steam shovels, of which 27 were at work in the canal prism, 2 outside the prism, 4 on the Panama R. R., and the rest set up and ready for work in various places." **P-06**, 7.

1907. Department embraced the Culebra division (from Chagres River to Pedro Miguel); Chagres division (between deep water in Lake Gatun and the Chagres River); the Colon dredging division (Gatun to deep water in the Atlantic); and the La Boca dredging division (taking in all the excavation between the La Boca Locks and deep water of Pacific), **P-07**, 2.
Culebra division: "That the preparation (mentioned in the annual report of Isthmian Canal Commission No. 3, 1906) was efficiently done and the organization effective is best attested by the results accomplished and the relatively small falling off of the output during the wet months; thus the amount of material removed from the Culebra Cut was 4,047,071 c. y., place measurement, from Jan. 1 to June 30, out of a total of 5,570,482 c. y. for the fiscal year."
Division, 10 miles long, subdivided into 5 construction districts, each under a superintendent of construction. Better results.
July to Sept., inclusive, output over 2,300,000 c. y. 77 working days. An average of about 40 shovels at work.
During rainy season dumps a source of delay; soft, impeding trains.
Surveys looking to preventing water from adjacent watersheds entering canal. Plans under way for carrying Obispo waters, etc., into Chagres River. **P-07**, 2, 3.
Chagres division: Preparatory work; surveys and borings; Chagres crosses this division 23 times; desirable that rockwork be done in

advance of excavation (in dry); steam shovels diverted from Culebra division to this division after close of fiscal year, P-07, 3.

Colon dredging division: Consists of Mindi and Colon districts; 700,000 c. y. to be shoveled in former; necessary preparations under way.

Dredging in progress, mostly in vicinity of dry-dock slip, and along the route of the old French canal as far as Gatun, the latter for transportation of materials to site of lock construction.

Dredging fleet: Old French ladder dredge, 5-yard dipper dredge, one 16″ suction dredge.

Under contract: Dipper dredge, and seagoing suction dredge, 6 steel hopper barges.

Dredges during year served by tug and 4 old French self-propelling clapets.

1,112,321 c. y., place measurement, dredged (43,602 c. y. rock), 17,000 c. y. being from canal prism.

Machine shop at Cristobal equipped with many pieces of new machinery.

Steps taken to enlarge dry dock, to take vessel 15′ by 50′ by 298′. P-07, 3, 4.

La Boca dredging division: Surveys continued to determine line of canal; test borings.

Dredging fleet: One old French ladder dredge and one 5-yard dipper. Second French ladder dredge, after repairs, put in operation about end of year.

Under contract: Seagoing suction dredge; to come by way of Cape Horn to Panama; 3 steel hopper barges.

Dredging plant served by 7 French self-propelling dump barges.

1,235,897 c. y. dredged, 64,352 c. y. of which taken from canal prism.

Machine shop at La Boca fairly well equipped for marine work; repairing and building of clapets, launches, etc. P-07, 4, 5.

1908. Embraces Culebra division, Chagres division, Colon dredging division, and La Boca dredging division, P-08, 2.

Equipment: Fourteen 70-ton steam shovels, sixteen 95-ton steam shovels, 292 Lidgerwood cars, and 668 12-yard dump cars added. With 200 more dump cars, equipment should be complete for this class. P-08, 2.

Culebra division: Division extends from Chagres River in the vicinity of Gamboa to include the Pedro Miguel Lock, a distance of 9.2 miles, P-08, 3.

12,065,138 c. y., place measurement, 11,685,253 c. y. being from canal prism. Steam shovels assigned, 59. P-08, 3.

Dumps, Culebra division: Greater part of material hauled over main line of Panama R. R. to Gorgona and Tabernilla on the north, and to two new dumps on the south, at Miraflores and La Boca. Average haul, 10 miles. Rock from the "cut" at Obispo taken to Gatun; since Mar. 20, 1908, 1,300 c. y. deposited daily on the south toe of the dam. P-08, 3.

Diversions, Camacho: French diversion channel on west side of canal utilized; new channel revetted with stone cut through White House yard, the French tunnel through the hill at Obispo cleared out, and a dam constructed across Obispo River. Waters carried from Culebra to the Chagres River, near Matachin. P-08, 3.

Diversion, Obispo: Survey for diverting Obispo River and other streams on the east side of the canal completed, a new channel located, and construction pushed. Channel finished from Gold Hill to a point opposite Las Cascadas. Waters to be carried into the Chagres River about 1 mile above the crossing of the river by the canal. 313,511 c. y. excavated. P-08, 3.

Slides, Cucaracha: Movement begun Oct. 4, 1907; 14′ in 24 hours, decreasing later to about 4′ a day. 113,000 c. y. stopped transportation through to the south. Work of excavating through carried on day and night; in a month trains going through. Area of slide, 34,455 sq. y.; 600,000 c. y. in motion. P-08, 3, 4.

Slides, Paraiso: Developed Apr., 1908. On east bank. Estimated area, 16,700 sq. y.; amount in motion, about 140,000 c. y. 90,000 c. y. removed. P-08, 4.

Slides, New Culebra: West bank. Area, 6,110 sq. y.; about 50,000 c. y. in motion. P-08, 4.

Slides, Las Cascadas: East bank. Area, 5,433 sq. y. In motion, 100,000 c. y. P-08, 4.

Slides: Uplift of bottom of cut, Culebra, corresponding with sinking; similar action just south of Gold Hill. Removing material on upper levels stopped sinking. P-08, 4.

Chagres division: Surveys of last year completed; center line of canal permanently marked. Saving of 1,264,700 c. y. made by slight change in alignment (264,300 c. y. being rock). Surveys show total of 12,256,300 c. y. to be removed, 8,313,500 c. y. being earth P-08, 5.

Excavation begun on four different sections—San Pablo, Caimito, Matachin, and Santa Cruz. Total excavated, 1,774,124 c. y. P-08, 5.

Overflow protection: Levees built at Santa Cruz and Matachin, and pumps and sumps installed, P-08, 5.

Equipment: Steam shovels, 15. Balance of equipment mostly French—47 out of a total of 50 engines French, and 410 of the 645 dump cars. P-08, 5.

Colon dredging division: Division extends from foot of Gatun Lock to deep water in the Caribbean Sea; embraced Mindi and Colon districts, and Cristobal marine shops.

Survey: Of Mindi district completed.

Clearing: Between Mindi and Limon Bay finished Aug.

Excavation: Begun with steam shovels July; 2 removed 536,959 c. y.

Levee: Built along low part of prism to protect cut from waters of French canal.

Dredging: Done by 2 French ladder dredges, 2 dipper dredges, a 16″ suction dredge, and by seagoing suction dredge "Ancon." Total, 5,087,623 c. y. removed, about 5,000,000 being from prism.

Machine shops: Additional machinery installed. Dredges received from U. S. and reerected.

Dry dock: Enlargement completed; capable of taking ship 15 by 50 by 295′. **P-08,** 5, 6.

La Boca dredging division: Limits extended by change in location of locks and dams on Pacific side, about 3 miles. Area to be dredged to extend from the Miraflores Locks to deep water in the Pacific (about 8 miles), with a width of 500′.

Excavation: Quantity to be removed, about 30,000,000 c. y., about 1,500,000 c. y. being rock.

Borings: Being made to determine amount and character of rock.

Rock removal: Experimental plant arranged for.

Channel alignment: Slight change made, with abandonment of the lock site at La Boca, so as to utilize the existing wharves of the Panama R. R. Co., as well as the dredging already done.

Plant: Suction dredge "Culebra," and 4 French ladder dredges; a dipper dredge part time.

Excavation: Over 5,270,000 c. y. removed (9,350 c. y. being from accessory works). **P-08,** 6.

Dump: Spoil from removal of Cardenas Hill dumped along the east bank of the Rio Grande, forming a dike for confining suction dredgings; over 55,000 c. y. utilized from canal prism.

Shops: Repairs, U. S. dredge reerected; shops in new location not subject to floods; fitted up for permanency. **P-08,** 6, 7.

Chagres division: Covers distance of about 23 miles. Extends from Gatun to a point where the canal crosses the Chagres River at Gamboa. River crosses canal 23 times in these limits; prism, hence, subject to overflows, producing delays. **P-08,** 5.

(See Atlantic division, Central division, and Pacific division.)

Excavation and Expenditures.
Charts showing, **P-09,** 180, pl. 76; **P-10,** pl. 124; **P-11,** pl. 119; **P-12,** pl. 95; **P-13,** pl. 103.

Excavation, Department of. (See No. 219, p. 2366 of this Index.)

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Cost, average, **P-13,** 245.
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Excavation, Operation. (See No. 264, p. 2368 of this Index.)

1914. Excavation for prism in dry, uncompleted at close of previous year, embraced Culebra Cut from Gamboa to Pedro Miguel Locks, channel Pedro Miguel to Miraflores Locks, and channel below Miraflores Locks to dike which excluded waters of Pacific. As noted in previous report, decision reached to admit water to cut by blowing up dike at Gamboa Oct. 10, 1913, and complete excavation by dredges. Excavation in cut carried on during July with average of 40.74 steam shovels; Aug., with average of 34.65 steam shovels; and Sept., with average of 14.62 steam shovels. These shovels worked not only in cut proper, but on upper reaches in vicinity of Culebra and on east side opposite Lirio. After water had been admitted to cut, 5 to 2 shovels worked on both east and west bank in vicinity of Culebra to lighten load. Work on east bank continued until Apr. 1, 1914, and on west bank intermittently until June 15, 1914. Last movement of considerable amount occurred on west side of Culebra just as steam shovels were withdrawn. Removed during year total of 3,122,702 c. y., 2,205,847 c. y. classified as rock. Work continued on Cucaracha slide, Culebra slides, Hagan's slide, Lirio slide, and powder-house slide until steam-shovel operations suspended; removed from these slides 2,635,902 c. y.; in other words, 84 per cent of material removed from cut due to slides. Total material removed in dry from Culebra Cut, from beginning of American operations to June 15, 1914, 110,261,883 c. y.; of this amount, 25,206,100 c. y. removed because of slides. This was increase of 4,940,100 c. y. over estimate in report for 1912. Steam-shovel operations in cut proper permanently suspended Sept. 10, 1913; estimated 600,000 c. y. remained to be removed by dredges from cut section within original limits of canal, exclusive of slides and inclines at north and south ends of cut. Practically all of this material lay between Cucaracha slide and point about midway between Culebra and Empire.

To prevent possible damage to canal due to velocity of current caused by difference in head between Gatun Lake level and bottom of cut, water admitted through 24″ pipe extending into lake under Gamboa Dike, these pipes remaining from old pumping plant located in vicinity to take care of drainage water north of divide. This done 9 a. m., Oct. 1. Work on drilling dike at Gamboa preparatory to demolition begun latter part of Aug.; holes loaded and fired Oct. 10, 2 p. m. Blast fired by President Woodrow Wilson, at

Washington. The President depressed lever, current relayed from point to point along the route to local circuit, closing it and tripping a weight attached to handle of switch. Weight threw switch, setting off blast. Result of explosion was clear opening 125′ wide through which water from Gatun Lake flowed in sufficient volume to complete filling cut from dike to Cucaracha slide in about 2 hours' time. Prior to dynamiting dike water in cut about 6′ below level of lake.

Oct. 10 after blowing up Gamboa Dike, effort made to dynamite passage through Cucaracha slide to flood cut between dike and Pedro Miguel Locks. Though steam shovels had been at work on slide with view to securing passage, on cessation of this work movement continued and completely blocked channel. Attempt to open passage by dynamite not successful; it was not until Oct. 12 that a stream of water was gotten through and area to south of slide began to fill. Dredges reached Cucaracha slide from north end Oct. 20 and from south end Oct. 24. Gamboa Dike attacked by dredges immediately after explosion. Channel finally dredged through Cucaracha slide to permit passage of dredging fleet, Dec. 13. With exception of small pocket slide in vicinity of Cascadas, admission of water to cut had no bad effects; no perceptible tendency for water to produce slides.

In central division 44.5 miles track removed July 1 to Oct. 10, 33.7 miles laid, and 294.81 miles shifted.

Sluicing to north of Gold Hill and to rear of Cucaracha slide continued, removing 1,384,455 c. y. rock and earth.

Material removed in dry from cut wasted bulk going to Balboa waste dumps, where 1,017,596 c. y. deposited, and on dumps along relocation of Panama R. R., where 920,748 c. y. placed.

South of Pedro Miguel Locks 306,700 c. y. excavated by fifth division. Of this, 20,510 c. y. from channel south of Pedro Miguel Locks and 286,190 c. y. from prism south of Miraflores Locks. Material was used as backfill to lock sand for sloping Miraflores Dam.

Total excavated in dry, Pedro Miguel to sea, since beginning of work, aggregated 4,819,969 c. y.

Berm and chamber cranes on west side of locks taken down and stored; 4 berm cranes, which formed part of concrete-handling plant during construction of Pacific Locks, used in connection with coal-handling plant at Balboa.

Steam-shovel work south of Pedro Miguel Locks stopped Aug. and south of Miraflores Locks Sept.; steps taken to remove tracks that remained within limits of canal channel. Last remaining barrier at Pacific end of canal dynamited 9.30 o'clock Aug. 31, 1913. This dike, composed of trestle fill of rock and earth, prevented water from sea level from entering steam-shovel cut, 46′ below mean tide by 500′ by 5,000′, extending to Miraflores Locks. Rio Grande diversion turned into this pit Aug. 23, but depth of water had only reached about 15′ Aug. 31. 37,000 pounds dynamite used, charge being placed in 541 holes at average depth of 30′. At time of explosion water in channel south of barrier nearly at low tide. Dynamite tore gap in dike about 100′ wide, but as bottom of gap was still at some height above existing tide level no water passed through until high tide, at 1.35 p. m. At 3 o'clock, 1 hour and 25 minutes after water first began to flow over, level in inside channel that of outside channel, while gap had been widened to 400′ or more. As noted in previous reports, two low places in the perimeter of Gatun Lake were to be raised to avoid possibility of waters of lake escaping—one was in vicinity of Gatun, and embankment built across it. Fill about 350′ long and containing 4,117 c. y. made, which raised surface to elevation 105, with crown width of 15′. Nov. 28, 1913, contract made for earth dike at Cano Saddle No. 4, along ridge 12 miles southwest of Gatun, to raise rim of Gatun Lake at that point to 105′ above sea level. Material involved 71,500 c. y.; completed May, 1914. Saddle between head-waters of Siri River and Lagarto River, which flows into Caribbean Sea. Surface of earth at lowest point, 87.4′ above sea level. Fill approximately 900′ long between 105′ contours on knolls at ends of saddle. It is 15′ at top, with slope of 1 on 3 both sides.

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  Second district, Pacific division, **P-09,** 100.

Excavation, Subaqueous.
  By districts, **P-14,** 237.

Executive Department. (See Civil Administration; see No. 103 and No. 271, pp. 2363, 2368 of this Index.)

1914. Department outgrowth of department of civil administration. Prior to reorganization, Apr. 1, department of civil administration under supervision of Mr. R. L. Metcalfe—appointed member of Isthmian Canal Commission Aug. 9, 1913, succeeding Commissioner M. H. Thatcher. He arrived on Isthmus Aug. 7, 1913. Since reorganization Mr. Metcalfe has been member of committee for formal and official opening of the Panama

Canal, created by Executive order May 20, 1914. Department embraces general office business of governor, work under supervision of executive secretary as already outlined, courts, and offices of special attorney, district attorney, and Canal Record. In charge of Mr. C. A. McIlvaine, acting under the governor.

Customs service: 280 vessels entered Balboa, total tonnage, 569,681; and 277 vessels cleared; total tonnage, 558,334. At Cristobal 295 vessels entered; tonnage, 832,579; and 296 vessels cleared; tonnage, 838,708. Usual customs services rendered seamen and vessels, and interests of Panama guarded by customs inspectors on wharves.

Estates: Estates of 452 deceased and insane employees of the Panama Canal and Panama R. R. Co. administered.

Posts: 13 post offices in operation, 6 of the 17 offices in existence at close of fiscal year 1913 discontinued, while 2 new offices established. The sale of postage stamps and postal cards, including the revenue derived from the sale of stamp books, amounted to $90,590.63, as compared with $100,485.54 for previous fiscal year, and $463.67 were collected for second-class mail matter, as compared with $318.84 for the preceding year. Money orders amounting to $4,029,364.83 issued. As compared with preceding year, decrease of $854,259.30 in amount, and decrease of $3,938.71 in fees collected. 5,113 postal savings accounts opened, 2,180 of which active at close, with deposits aggregating $498,481. Total deposits for year, $1,708,530, as compared with $1,601,616 for previous year. In addition there were on deposit at close of year $70,750.41 in form of money orders issued and drawn on zone post offices payable to remitter.

Schools: Opened Oct. 1, 1913, with enrollment of 2,167 children—1,109 in white schools and 1,058 in colored schools—as compared with 2,199 during Oct., 1912. Total during year, 1,270 in white schools and 1,492 in colored schools. In addition to white schools at Gorgona and Toro Point and colored schools at Gorgona and Matachin, closed in 1913, the white school at Bas Obispo and colored schools at Miraflores, Pedro Miguel, and Cruces not reopened, and schools permanently closed at Mandingo Dec. 19, 1913, Marajal colored school Feb. 6, 1914, branch high school at Empire on Feb. 20, 1914, white school at Porto Bello Apr. 24, 1914, and colored school at Cucaracha May 29, 1914, $1,089 collected as tuition from nonresidents of zone, as compared with $744 during 1913. Medical inspection of white schools continued, fire drills inaugurated, and hand chemical extinguishers installed. Public-school athletic league formed in white schools, and annual meet of league held June 12, 1914, in canal clubhouses at Balboa, Corozal, Empire, Gatun, and Cristobal; 198 participants.

Police and fire division: Police, prisons, and fire protection consolidated Apr. 15, 1914, under designation "police and fire division." Positions of assistant chief of police, fire chief, and assistant fire chief abolished and position of fire inspector created. Station at Gorgona and substation at Matachin closed July 17, 1913. On Aug. 31, 1913, call station at Matachin abolished, and Dec. 15, 1913, station at Bas Obispo abolished. July 18, 1913, call station at Cucaracha abolished. On Sept. 14, 1913, station at Miraflores abolished; also station at Las Cascadas on Dec. 15, 1913. Mount Hope station abolished Apr. 15, 1914; station at Paraiso on same date, and station at Porto Bello May 13, 1914. Arrests totaled 4,911—4,455 males and 456 females—as compared with 6,827 arrests for previous year. 5,021 charges—4,713 misdemeanors and 308 felonies. Of total arrested, 3,927 convicted. 75 convicts confined in penitentiary June 30, 1914, as compared with 133, 1913. Operation and supervision of markets and slaughterhouses of zone turned over to police division July 16, 1913. At Empire 1,533 animals killed. Rentals derived from stalls and tables in public markets, $2,599.75. Five markets in operation June 30, 1914, three having been discontinued during year.

Sept., 1913, fire station, together with equipment, at Gorgona removed to Corozal, and one-man volunteer fire station at this point discontinued. Las Cascadas station closed Apr. 30, 1914, and apparatus and equipment desired by military authorities at that point transferred to them. Equipment withdrawn from Bas Obispo and Porto Bello stations Aug. 20, 1913, and May 6, 1914, respectively. Fire pump and turret nozzle removed from tug "Bolivar" during preceding year, installed on clapet "No. 7," Aug., 1913, to provide water-front and harbor fire protection at Balboa. Fire protection provided new piers, Nos. 8 and 9, Cristobal. 215 alarms responded to, 8 false; of 207 actual fires, 98 occurred in property of Panama Canal, 14 in Panama R. R. property, 27 in private property, and 68 in grass, rubbish, dumps, etc., on zone. Of fires in private property, 11 occurred in Colon, 1 in Panama, 1 at old Porto Bello, in Republic, and 14 in zone. Largest fire in zone Jan. 3, 1914, in pile of creosoted and untreated piling stored about three-quarters mile south of shops at Balboa, where it was impossible to drive apparatus. Automobile fire engine loaded on flat car and hauled to scene. Total loss to Panama Canal, $14,551.71.

Courts: Supreme court held 24 sessions, disposed 29 cases—3 criminal, 25 civil, and 1 habeas corpus—and ceased to exist June 30, 1914.

Circuit Court of Third Judicial Circuit, Cristobal, last criminal session Mar. 26, 1914. At Ancon last regular session of Circuit Court of First Judicial Circuit held Mar. 30, 1914; and at Empire last regular session of Circuit Court of Second Judicial Circuit held Mar. 31, 1914. While further business relating to these courts formally ordered over to new district court Apr. 1, they continued to act on civil cases until May 1, pending confirmation of appointment of new district judge. In circuit courts, July 1, 1913, to May 1, 1914, 395 criminal cases filed and 4 cases pending July 1, 1913, making total of 399. Of this total, 370 cases disposed of, leaving 29 pending May 1, 1914. 158 civil cases filed during period and 51 civil cases pending July 1, 1913. Of this number, 179 disposed of, leaving 30 civil cases pending. 435 probate cases filed, which, with 57 probate cases pending July 1, 1913, made total of 492 probate cases before court. Circuit courts held 225 sessions. District courts discontinued Apr. 1, 1914. July 1, 1913, to Apr. 1, 1914, 4,183 cases settled, 3,656 of which criminal. Pending July 1, 1913, 35 civil and 3 criminal cases, and pending Apr. 1, 1914, when courts closed, 1 civil case.

On Apr. 1, 1914, courts of zone ceased to exist, pursuant to provisions of Executive order Mar. 12, 1914, with exception of supreme court, which went out of existence June 30, 1914. The judiciary created by act of Congress consists of district court and two magistrates' courts. District court consists of two divisions, known as Balboa division and Cristobal division. Former includes all that part of zone within lines of 10-mile zone and extends from south bank of Chagres River and shore line of Gatun Lake, 87′ above mean sea level, to Pacific Ocean. Latter includes all territory within lines of 10-mile zone extending from Balboa division to Atlantic Ocean and area of Gatun Lake beyond lines of 10-mile zone up to contour line of 100′ above mean sea level and islands and peninsulas in and bordering on Gatun Lake taken by U. S. for Panama Canal. A magistrate's court for both Cristobal and Balboa, jurisdiction of each covering that division, into which zone is divided as described for district court, in which town is located.

District court has original jurisdiction of all felony cases, all causes in equity and admiralty, all cases at law involving principal sums exceeding $300, and all appeals from judgments rendered in magistrates' courts. Jurisdiction in admiralty of district court is same as that exercised by U. S. district courts and procedure and practice are same. Circuit Court of Appeals of Fifth Circuit of U. S. has jurisdiction to review, revise, modify reverse, or affirm the final judgments and decrees of district court of zone in certain cases, and final appeal may be had to Supreme Court of U. S. in same manner as appeals from district courts of U. S.

Magistrates' courts have exclusive original jurisdiction throughout subdivision in which situated of all civil cases in which principal sum claimed does not exceed $300, and all criminal cases wherein punishment that may be imposed does not exceed fine of $100 or imprisonment not exceeding 30 days, or both; all violations of police regulations and ordinances and all actions involving possession or title to personal property or forcible entry and detainer of real estate. Magistrates also hold preliminary investigations in charges of felony, and commit or bail in bailable cases to the district court.

In district court under new judicial system during May and June, 1914, 206 cases settled—9 civil, 120 probate, and 77 criminal. In magistrates' courts 1,203 cases settled, leaving 18 cases pending.

Negotiations carried on with Republic included following: Enforcement of quarantine; regulations; establishment of rates for transportation of passengers by automobile between points in zone and Panama and Colon; enforcement of sanitary rules and regulations; use of revenue stamps on bills submitted by Isthmian Canal Commission and Panama R. R. against Republic; new contract for street cleaning and garbage removal in Panama; charge for interments in zone of remains of persons who resided in Republic; water supply for village of Taboga; certification by Panaman consuls of manifests of ships clearing for ports of zone; jurisdiction of U. S. over islands and peninsulas in Republic formed by waters of Gatun Lake; sale in Republic of dynamite stolen from Panama Canal; collection of burial fees for interments in zone cemeteries of indigents from Republic; assessment of commercial tax by Republic on steamers of Panama R. R. Steamship Co.; improvements in Chorrillo district of city of Panama; misuse of transportation issued to employees of Republic; modification of existing arrangement for purchase of postage stamps used in zone; sale of old administration building in city of Panama; water supply for section of Panama known as "El Hatillo"; cooperation of Republic health officers with those of zone in effort to prevent introduction of plague into Panama from infected ports on west coast of South America; enforcement of exclusion law in zone; use in zone post offices of U. S. postage-due stamps; modification of existing agreement respecting release of mail parcels received by gold employees through zone post offices; arrest in Panama of Panama Canal employees while engaged in discharge of duties; care of patients by health department for Republic in consideration of withdrawal of request of Panaman Government for establishment of independent hospital in Colon; removal of garbage and street cleaning in city of Panama; construction in Republic of military trails at expense of U. S.; segregation of stables in city of Panama within certain areas; desirability of having Panaman Government cancel licenses for five saloons near zone boundary line; granting of commissary privileges to certain persons not connected with Panama Canal or Panama R. R.; deportation of American in city of Panama charged with fraudulently representing himself as attorney

licensed to practice in zone courts; deportation of criminal characters from zone; violation of quarantine regulations; securing of statistics concerning health conditions in interior towns of Republic; promulgation by Panama of resolution with reference to manifests of vessels arriving at ports of zone with cargo for consignees in Republic; substitution of properly surcharged stamps of Republic for surcharged U. S. postage-due stamps used in zone post offices; installation and cost of municipal improvements in area in Colon set aside for erection of manufacturing plants; protection of revenues of Panama in connection with parcel-post entries into zone; and admission to Ancon Hospital, as pay patients, of Americans residing in Republic who, on account of character of their employment, not entitled to hospital privileges. Relations with Republic and with foreign representatives satisfactory.

Time keeping: Time-keeping work centralized; time keeping of all departments and divisions, with exception of Panama R. R., done by time-keeping bureau.

Clubs and playgrounds: Division of club houses continued to exist to Mar. 31, 1914, when, in reorganization, it became bureau of clubs and playgrounds. Activities conducted under supervision of secretaries furnished by Y. M. C. A. Gorgona clubhouse closed Aug. 1, 1913; removed to Pedro Miguel; reerected and opened Jan. 27, 1914. Porto Bello clubhouse closed May 1, 1914; being reerected with improvements as clubhouse for colored men at La Boca. Decided to inaugurate system of playgrounds in permanent towns of zone; equipment and supervision under jurisdiction of this bureau.

Canal Record: Canal Record continued under direction of secretary of the commission, Mr. Joseph Bucklin Bishop, until Apr. 1, 1914, when he was designated special secretary and continued in charge until July 1, when he resigned. Record transferred to charge of executive secretary.

Law: Law department continued in charge of Judge Frank Feuille until Apr. 1, when reorganization became effective. Since Apr. 1 Judge Feuille continued as special attorney for purpose of codifying laws of zone and to defend interests of U. S. before joint land commission in acquisition of lands in private ownership taken over in accordance with Executive order of Dec. 5, 1912.

Number of Executive orders of legislative character issued, the more important of which were orders prohibiting flights over the Isthmus by machines; providing punishment to deported persons returning to zone; fixing legal rates of interest; prohibiting gifts or gratuities to agents, employees, or servants; providing punishment for persons engaged in practice of hunting deer or other animals at night by use of lanterns or torches; to establish permanent organization for zone; and order conferring power upon governor of zone to remit fines and forfeitures, to grant pardons, reprieves, and commutations of sentences, and to establish system of paroling prisoners.

Joint land commission, appointed under Panama Canal treaty between U. S. and Panama, in session from July 1 until middle of Sept., when one American commissioner resigned, his resignation being followed by that of the other American commissioner. Commission heard and disposed of 1,253 claims; 602 were dismissed, awards made in 629, disagreed in 22. During same period law department settled 752 claims, aggregating the sum of $48,659. From discontinuance of joint land commission until end of year law department adjusted 1,528 claims; so that total claims settled without intervention of joint land commission during year was 1,903, aggregating $147,452.50. On May 25, 1914, joint land commission reorganized with Messrs. Federico Boyd and Samuel Lewis, who served on previous commission, and Messrs. Levi Monroe Kagy and David Marks, the two American members. Work of commission interrupted by death of Commissioner Marks, at Ancon Hospital, July 17, 1914.

Leases for lots in Culebra and Empire districts, including villages of Empire, New Empire, Camacho, Golden Green, New Culebra, Cow Pen, and West Culebra, canceled on behalf of Panama R. R., June 30, 1914. At the same time leases for Panama R. R. lots in New Gatun canceled, but cancellation did not become effective until after close of year. **P-14,** 54-62.

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Fifth Division. (See No. 255, p. 2368 of this Index.)

1913. Pacific division abolished Dec. 12, 1912, and fifth and sixth divisions of O. C. E. organized.
Fifth division has charge of construction of locks, dams, spillway, excavation in dry in prism between and below locks, operation of Ancon quarry, municipal engineering work

within area covered by works of division, and such sanitary engineering work as prescribed by sanitary department within area. Work in charge of H. O. Cole as resident engineer. Excavation of Pedro Miguel Locks completed by removal of 3,044 c. y. from locks. Bulk of excavation consisted of removal of French dump east of lock site; material utilized for back fill. In addition to excavation for completing locks, 2,190 c. y. removed for construction of northeast core wall built to prevent passage of water back of east wall. Excavation done by hand, and extended under tracks of old Panama R. R. in use by central division. To prevent flooding locks, cofferdam left to south until completion of concrete work of locks, and subsequent increase in length of south approach pier to 1,200′ prevented its completion until after cofferdam could be removed. In preparing foundations for guide pier and for wing walls 15,366 c. y. removed, of which 10,701 c. y. rock. Total excavation for locks, approach piers, and guide walls, including preparation of foundations, 1,319,742 c. y. Total concrete placed during year, 58,367 c. y., mixed entirely by auxiliary mixers consisting of two 2-cubic yard mixers at north end of locks on west side and of average of 3.05 ½-cubic yard mixers, moved about as necessity required. Concrete handled either by derricks and locomotive cranes or dumped direct into place through chutes. Of this, 39,465 c. y. were plain concrete and 18,902 c. y. reinforced concrete. Total concrete placed prior to July 1, 1913, in Pedro Miguel Locks, 906,293 c. y.

Back filling of lock, wing walls, and center wall completed, and riprap finish at ends of south wing walls partially placed. Amount used in back fill, 367,150 c. y., of which 193,212 c. y. were in center wall, balance behind side walls. Total back fill placed to June 30, 1913, 806,538 c. y. back of lock walls and 215,149 c. y. in center wall. West dam at Pedro Miguel, consisting of rock-filled sides and puddled-clay core, completed and top finished at elevation 107 with clay. North face riprapped with hard stone at 85′ level. 114,117 c. y. fill added, making total in dam 696,558 c. y.

Miraflores Locks carried to completion. Foundation work for lower west wall seriously interfered with and retarded by slides and by water-bearing strata of banks. In some places necessary to build retaining walls to prevent mud from flowing onto foundation areas; and slides carried away berm-crane tracks, necessitating use of auxiliary concrete mixers for laying wall bases sufficiently high to secure bearing for berm-crane tracks. Similar difficulty experienced with south guide walls, especially on east side of locks, which could be built only in small sections. Concrete would be pushed as far as possible, then stopped until another portion of slide could be removed; in this way slide gradually encroached upon until guide or flare wall completed. North flare walls founded on piles; on west side of locks piles driven in marsh and weight supported entirely by friction on piles. While back filling, this portion of wall constituting return bulged slightly; further movement checked by depositing material along face of return, adding counterweight.

Center approach piers constructed to full length of 1,200′ each from angle of flare walls. North wall of cellular reinforced concrete construction and founded on concrete caissons sunk to rock. Caissons consist of reinforced concrete shells 7½′ in diameter and 1′ thick, built up in sections 6′ long and sunk progressively, bottom shell fitted with steel shoe for cutting edge. Caissons sunk to bedrock at average depth of 29.43′ and filled with concrete, forming solid columns to rock They were spaced 15′ centers longitudinally and 27′ centers transversely. Wall then supported on heavily reinforced concrete girders spanning caissons in both directions. South approach wall of massive concrete and founded on natural rock.

Construction plant, consisting of 4 berm and 4 chamber cranes, supplied concrete. Total concrete laid in Miraflores Locks during year, 450,792 c. y., of which 402,607 c. y. plain concrete and 48,185 c. y. reinforced concrete. Of total, 308,914 c. y. laid by 4 berm cranes. Chamber cranes handled 218,135 c. y. concrete and 92,359 c. y. fill for center wall. Concrete furnished in part by mixers on berm cranes and by 2-yard mixers on east wall, operated July 1, 1912, to Oct. 26, 1912, producing 97,603 c. y. In addition to regular plant, average of 3.12 ½-yard portable mixers used. Total concrete laid in Miraflores Locks to close of year, 1,476,895 c. y. Concrete in locks proper completed May 17, except reinforced concrete floor and stairway in middle wall at junction of upper and lower locks, completed June 10. There remain to be completed lamp-post bases, snubbing-button bases, parapets around stairways, and nosing at end of south center approach pier, added during year to completed plans. Total concrete laid in Pacific Locks, July 1, 1913, 2,382,983 c. y.

Back filling lock walls continued with material from locks and prism excavation and aggregated 1,128,769 c. y., of which 149,301 c. y. were in center wall. Total back fill placed behind walls to June 30, 1913, 2,006,054 c. y., and in center wall 157,213 c. y. Sept. and Oct., 1912, 9,896 c. y. excavated for spillway dam by hydraulic method. Owing to limited space and excessive rainfall this method abandoned; no work done until beginning of dry season; excavation resumed by steam shovels and by hand. Situation complicated by fact that central division tracks for hauling spoil from cut to south passed through spillway site, and it was desired to give central division as much advantage during dry season as possible. Assumed that spillway must be completed by Sept. 1, 1913. To meet this required removal of central division tracks from site by Mar. 1, 1913; not accomplished until Mar. 4, and when excavation of entire site could proceed, found that more material had to be removed than was estimated, and greater amount of concrete needed. Difficulty experienced due to fact that Rio Grande passed through site of dam and had to be diverted twice. After concrete for west end of dam brought up to elevation of bottom of river, dike constructed confining water to space sufficient to enable it to discharge through opening left in concrete of dam, and another dike built on south side to confine water after passage through opening. After these were finished further trouble from this source avoided. To credit of those engaged in construction, structure completed, notwithstanding difficulties and delays, Sept. 1, 1913, including placing of gates and erection of steelwork for walk way on top. Opening for passage of Rio Grande left until gates at Pedro Miguel completed. In addition to material removed by hydraulic method, 124,775 c. y. excavated by steam shovels, hand, derricks, and cranes, completing excavation for spillway dam.

Total concrete laid in spillway, 64,142 c. y., of which 63,707 c. y. plain concrete and 435 c. y. reinforced concrete. In laying this concrete narrow-gauge tracks laid from berm cranes located on east side of locks to south toe of dam, ending in various spurs leading to derricks which handled concrete mixed by berm cranes and delivered on transfer cars in 2-yard buckets. Berm cranes mixed for use at spillway 27,619 c. y. In addition, average of 1.43 1-yard mixers and 1 ½-yard mixer supplied 38,551 c. y. West dam at Miraflores completed, with exception of junction of dam with back fill along west lock wall. Hydraulic fill in west dam completed during previous year and total dry fill added was 418,375 c. y. As this dry fill was advanced over hydraulic fill, softer material crowded to center and increased in height and, as it was not sufficiently hard to bear tracks, outlet was cut on west side of dam through which much of soft material crowded out, assisted by water jet. What remained pushed over on west slope of dam by raising and crowding east dry fill.

Excavation in dry between Pedro Miguel and Miraflores Locks and south of locks continued, spoil being used for back filling lock walls, for dams, and filling swamp areas on east and west sides of canal. Total removed, 379,626 c. y. To divide more equally excavation between steam shovels and dredges, to keep latter at work, new dike built across canal 3,300′ north of old one. After closing down hydraulic excavating plant which had excavated area between these dikes to rock at elevation approximately minus 20, area drilled to minus 45 and blasted preparatory to being excavated by dredges after area rewatered. Steam shovels, prior to turning in of water, took out 59,000 c. y. rock. Lower dike drilled to grade and blown up May 18, advancing water to new dike. Total removed below Miraflores Locks by steam shovels, 2,949,943 c. y.

Total dry excavation in prism, 3,120,851 c. y.

Ancon quarry operated for about 3 years without general overhauling until May 16, 1913, when it was shut down for 10 days for putting in various repair parts. Small No. 5 gyratory crusher, taken from old Rio Grande quarry, installed on floor of south end of rock bins for crushing larger rock to supply increased demand for smaller-sized stone. Total produced, 688,301 c. y., of which 424,860 c. y. placed in storage, 21,301 c. y. supplied to municipal division, and 161,311 c. y. supplied to other divisions and departments.

Hydraulic excavating plant continued at work until Dec. 1, 1912, when it was taken out of service. Material removed used for reclaiming tidal swamp lands east of and adjacent to prism. Total removed, 451,631 c. y., making total removed by this method 1,549,904 c. y.

Plant still in serviceable condition, and suggestion made that at least part be utilized in sluicing soft material found on north side of Gold Hill and on top of east bank of Culebra Cut. Bank had been to a certain extent stepped back by steam shovels in process of lightening loads on upper part of bank, but this work stopped Aug., 1912, on score that Lidgerwood cars could not be spared for this service and that material could not be handled economically with steel side-dump cars during wet season. Rain had cracked bank badly and part had sloughed off into cut. To the north and east of Gold Hill lies valley of the Obispo, and material excavated by steam shovels on this upper bench deposited on dump extending almost across valley of river. By continuing dump entirely across valley and placing culvert pipes through dam that would result, water could be allowed to flow through former channel and Obispo diversion to Chagres River. By tilting these pipes upward on south side of dam they would form spillway to any pool that dam might make; calculations indicated sufficient pool could be created to furnish water for pumps to sluice back into depression to east some clay that would otherwise fall into cut. After renewed activity of Cucaracha slide, decided to make use of sluicing plant for this purpose. Location for pumps and pipe line such that rear of Cucaracha Hill could be taken off and washed back into valley to east by relay pumps and whatever material remained on cut side of Cucaracha Hill could be washed down to dredges, thereby finishing Cucaracha slide for good and all. Work placed in charge of resident engineer of fifth division. Work on

installation of hydraulic pumping mains and flumes started Feb. 1, 1913. Two boilers and two Worthington pumps erected, with necessary flumes. Dam has created lake of 180 acres, with drainage area of 4 sq. m. Elevation at bottom of suction at pumping plant, 214′ above sea level, and elevation of pipes forming spillway 228. Material washed back into depression which forms lake, and discharges at such a distance from pumping plant that water used in sluicing returned to lake and used over again, requiring only small inflow to keep lake at constant elevation. Sluicing begun June 17, 1913, and 57,274 c. y. removed by this method. Booster pumps ordered; when received, operations for attacking rear of Cucaracha Hill will be begun.

To meet increased demand for water at Ancon and Panama, two pressure filters removed from Miraflores power house and installed in Ancon filtration plant. On account of future inundation, 16″ Rio Grande water main taken up between Pedro Miguel and Miraflores power house, and work of relaying it along Panama R. R. line partially completed at close of year. Construction work on locks made it necessary to relay portions of 10″ main between Cocoli pumps and junction with 16″ main at Miraflores power house.

Grading completed on new road, Diablo to Ancon, and macadam partly placed and rolled at close of year. Work on road included construction of 20′ span concrete bridge over Corundu River.

Work started on permanent town site at Balboa in Mar. and included installation of 750 linear feet of reinforced concrete storm sewer and 1,222 linear feet of reinforced concrete drains, filling hydraulically of a portion of town site with material pumped from inner harbor excavation, laying out permanent laborers' barracks, and location of permanent administration building. In connection with latter, 36,500 c. y. material excavated preparatory to installation of foundations, concrete piers for columns placed, and erection of steel frame for superstructure begun.

Sanitary work consisted of cleaning 593,127 linear feet of earth drains, excavating 5,079 c. y. of new earth drains, sweeping 1,023,352 linear feet of cement drains, filling 2,862 c. y. of holes and swamps, laying 2,520 linear feet of tile drains, constructing 10,566 linear feet of cement drains, and clearing 131 acres of vegetation. **P-13**, 28–35, 161.

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  1912. When it was determined to fortify the canal, recommended that construction be done by Isthmian Canal Commission, utilizing forces and such plant as could be spared from other work under its charge. Proposed at same time, in order that completed work might embody latest improvements in battery construction, that plans be prepared by the Chief of Engineers, U. S. Army, subject to approval of Panama Fortification Board, and batteries and accessories built in accordance. Recommendation received approval at Washington. **P-12,** 1.
  Act Mar. 4, 1911, appropriated $2,000,000 for gun and mortar batteries for defense of canal against naval attack. Work commenced Aug. 7, 1911, under provisional organization which continued until Jan. 1, 1912, when work was consolidated and placed in charge of Lt. George R. Goethals, U. S. Army, reporting to chief engineer. 408,392 c. y. excavation done, 5,159 c. y. concrete laid, and channel excavated to one of islands by dredging 32,150 c. y. **P-12,** 1, 47.
  1913. By act Aug. 24, 1912, $1,000,000 appropriated for gun and mortar batteries, making total appropriated $3,000,000, sufficient for completion of this portion of work. In addition, $200,000 appropriated for land defenses. Work continued on gun and mortar batteries. Detailed surveys for location of land defenses well advanced to completion and arrangements made to begin work July 1, 1913, on construction of redoubts in accordance with plans prepared by board appointed by Sec. of War. 416,542.5 c. y. excavation done, 131,952.8 c. y. concrete laid, 93,808 linear feet piling driven, and 100,957 c. y. filling done by one dredge. Work in charge of Lieut. George R. Goethals, U. S. Army, assisted by Lt. A. H. Acher, U. S. Army, and R. M. Elder and H. P. Warren as superintendents of construction, **P-13,** 49.
  1914. Work continued during year on gun and mortar batteries; by close of year concrete work practically completed, as well as greater portion of back fill. July 1, 1913, construction of redoubts in accordance with plans prepared by a board appointed for purpose and approved by Sec. of War undertaken; completed, as well as clearing necessary in connection with them. **P-14,** 65, 66.

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Acts governing, **P-11**, 560, 562; **P-12**, 595.
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Congress, Feb. 27, 1906, removed restrictions of 8-hour law from application to alien labor in the zone work, and to the foremen and superintendents of such laborers. Again, June 30, 1906. **P-06**, 14.

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Hydraulics. (See Nos. 138, 197, pp. 2364, 2365 of this Index.)
Condition of ground, Gatun Locks, **P-08**, 70, pl. 41.
Hydraulic conditions, Miraflores Spillway, **P-14**, 158.
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Hydraulics, Isthmian.
Panama Canal: Paper by Henry L. Abbot, as Appendix E, Report of Board of Consulting Engineers.
Some of the hydraulic problems of a sea-level Panama Canal: Topography of the canal route; discharge of the tributaries below Gamboa; volume of freshets and great floods; conclusions that for a sea-level canal there must be a tidal lock at Miraflores, a dam at Gamboa, spillways, and over 40 miles of artificial and very costly diversion channels for tributaries entering below Gamboa, etc. **P-06***, 185-191.
Water supply of the canal for three variants, assuming a lake at Gatun raised to elevations 85′, 60′, and 30′, the latter combined with a lake at Bohio raised to elevation 60′: Flow of the rivers; requirements for lockage; other losses of water; volume of water reserves; storage of the reserves. **P-06***, 192-197.

Hydraulics, River, P-07, 58; **P-08**, 68. (See Hydrography.)
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Hydroelectricity. (See Electricity.)

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Gatun Lake, **P-12**, pl. 105; **P-13**, pls. 110, 111.

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  Surge, Culebra Cut, on locking, Pedro Miguel, **P-14,** pl. 112.
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  Schedule bond for employees, **P-12,** 412.

Illumination, P-14, 114.
  Aids to navigation, **P-12,** 104.
  Calculated, Balboa shops, **P-14,** 175.
  Gatun Locks, **P-14,** pls. 87, 88, 89, 90.
  Illuminants and, **P-13,** 109.
  Locks, **P-12,** 92; **P-13,** 96.

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  Act relating to status of persons entering U. S. from zone, **P-11,** 558.
  Employees, **P-07,** 141.
  Statement of, **P-08,** 252.

Immigration Restrictions.
  Isthmian Canal Commission No. 3 authorized excluding undesirable immigrants; this restriction inapplicable to Panama, so that undesirables simply landed in Panaman territory and finally landed in the zone a burden therein. Panama, on suitable representations, issued a decree, Mar. 17, 1906, banning undesirables from entrance into her territory. **P-06,** 20.

Importations.
  Employees, by, **P-07,** 151.
  Orders, etc., relating to, **P-05,** 202.
  Orders relating to imports for employees, **P-05,** 208.

Improvements, Public. (See Engineering; Municipalities; see No. 215, p. 2365 of this Index.)
  Map showing Panama improvements, **P-10,** pl. 118; **P-12,** pl. 94.

Indio River. (See No. 22, p. 2361 of this Index.)

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  Work of mechanical division for, **P-14,** 253.

Industries. (See Nos. 24, 53, pp. 2361, 2362 of this Index.)
  Revived by U. S. occupation, zone and adjacent cities, **P-05,** 53.

Injuries. (See Employees.)
  Claims for, **P-11,** 392, 432; **P-12,** 415; **P-13,** 415; **P-14,** 329.
  Computation of pay, **P-13,** 622.
  Employees, act relating to compensation, **P-11,** 568, 569, 581.
  Employees, statement, **P-09,** 246; **P-10,** 355; **P-11,** 404, 405.
  Executive order relating to compensation for injuries, **P-13,** 620, 625.
  Liability of Panama R. R., **P-11,** 565, 575.

Insane. (See No. 97, p. 2363 of this Index.) (See Hospitals.)
  Executive order relating to, **P-11,** 433.
  Insane, lepers, and indigent sick, care of: Provision made for the care of. Hospitals repaired. Panama reimbursed U. S. for portions of the work. Panama hospitals under oversight of U. S. Per capita charge for Panaman patients, 30 cents per day. **P-05,** 51.

Inspections.
  Boiler-inspection service, **P-10,** 269; **P-11,** 239; **P-12,** 274.
  Division of general inspection, **P-12,** 410.
  Division of time inspection, **P-12,** 412.
  Emergency dams, **P-13,** 101.
  Equipment, **P-13,** 247.
  Inspection department established, machinery and electrical equipment, **P-11,** 82.
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  Organization, division of canal transportation, **P-14,** 263.
  Shops, duties of inspectors, **P-11,** 218.
  Steamboats, **P-10,** 365; **P-11,** 416; **P-12,** 458; **P-13,** 462, 615; **P-14,** 264.
  Supplies, **P-08,** 223.
  Terminal construction, **P-14,** 166.
  Water service, **P-07,** 78.

Inspectors, Board of Local, P-14, 262.

Insulators.
  Electric transmission line system, **P-14,** 101.

Insurance. (See Orders, Executive.)
Panama R. R. prohibited from carrying, act, **P-11,** 566, 577, 580.

Interest.
Usury and, **P-14,** 563.

Intermediate Gates. (See Gates; see No. 249, p. 2367 of this Index.)

Intermediate Lock Gates.
Special report on, by Lt. Col. H. F. Hodges, Corps of Engineers, U. S. Army. Member Isthmian Canal Commission No. 4. **P-10,** 65.

Internal Revenue. (See Civil Administration; see No. 111, p. 2363 of this Index.)
Nine distilleries in active operation, **P-08,** 34.

Inventory. (See Property.)
Inventory and property returns, **P-08,** 227.

Investigations. (See Dams; see Nos. 232, 244, pp. 2366, 2367 of this Index.)

Investigations, Special.
Currents, Colon Harbor; and leakage, Gatun Spillway gates, **P-14,** 156.
Gatun Dam studies, by C. M. Saville, **P-08,** 127–196.

Iron. (See Foundries.)
Castings of, output and cost, **P-13,** 262; **P-14,** 258.
Covers of cast iron, **P-12,** 92.
Foundries, **P-10,** 272; **P-11,** 241.
Scrap iron, sales, **P-11,** 359.

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Design and contract, **P-13,** 74.
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For rising gate stem valves, **P-13,** 87.
Lock gates, **P-13,** 81.
Milling machine for correcting, rising stem valves, locks, **P-13,** 110, pl. 11.
Pacific locks, **P-12,** 179.
Spillways, spillway gates, caissons, footbridges, and railings, **P-13,** 74.
Valves and fixed irons, locks, **P-13,** 74.

Isthmian Canal Commissions. (See p. 2359 of this Index.) (See Nos. 1–256, pp. 2361–2368 of this Index.)
Isthmian Canal Commission No. 1: Letter from John Hay, Sec. of State, June 10, 1899, announcing to Rear Admiral John G. Walker (retired) the latter's appointment as a member of the Isthmian Canal Commission or investigators referred to by act Mar. 3, 1899, authorizing the President to make full and complete investigation of the Isthmus of Panama, particularly those routes known as the Nicaragua and Panama routes, with a view to ascertaining the best route for an interoceanic canal and the cost of the same and placing it under the control, management, and ownership of the U. S., embracing the cost of all rights, etc., acquired by all former enterprises; and authorizing the President to employ any engineers or others to carry out the details. The act also sets aside $1,000,000 for expenses, and requires the President to report to Congress the results of such investigations, together with his recommendations. Copy of act referred to. **P-99,** 10, 11.
Organization of commission by committees (the President being ex officio a member of each committee): Investigation of Nicaragua route, Mr. Noble, Mr. Burr, Col. Hains; investigation of Panama route, Mr. Burr, Mr. Morison, Lt. Col. Ernst; investigation of other possible routes, Mr. Morison, Mr. Noble, Col. Hains; investigation of industrial, commercial, and military value of an interoceanic canal, Mr. Johnson, Mr. Haupt, and Mr. Pasco; investigation of rights, privileges, and franchises, Mr. Pasco, Lt. Col. Ernst, and Mr. Johnson, **P-99,** 12.
Assistants: On July 6, 1899, Lt. Commander S. A. Staunton, U. S. Navy, chosen secretary, **P-99,** 13.
Chief hydrographer, A. P. Davis. Appendices D and I. **P-99,** 219, 281.
Lock studies, S. H. Woodward. Appendix A. **P-99,** 179.
Special surveys, A. B. Nichols. Appendix J. **P-99,** 349.
Special commercial report, Prof. E. R. Johnson (member of commission). Appendix NN. **P-99,** 515–673.
1899–1901. Operations: Organization; law authorizing commission; instructions to commission; committees named; subjects of investigation (see Engineers); appointment of chief engineers, one for Nicaragua and one for the Panama route, third engineer appointed to direct field work at Darien, **P-99,** 13.
Employment of assistants and laborers: 20 working parties organized in Nicaragua, 5 in Panama, 6 in Darien; total field force, about 850. Chief engineers directed to make examination of geography, topography, hydrology, and other physical features of the different countries, and to make a special study of the routes in Panama and in Nicaragua. Commission visited Paris, 1899. New Panama Canal Co. permitted inspection of all its records, etc. Commission visited various canal works in Europe. Visit made to Central and South America in 1900. **P-99,** 14.
Darien visited by Mr. Morison. U. S. S. "Scorpion" used by commission. Officials of the various countries consulted and conferred with. **P-99,** 15.
Upon return to the U. S., commission considered dimensions and unit prices. Conclusions reached used in making subsequent plans, computations, and estimates. Other questions considered, such as treaty relations, grants and concessions already made-value of the canal, operation and maintenance, etc. Second visit made to Nicaragua by Mr. Noble, 1901. Parties disbanded, as they finished their work, the engineers being brought to the U. S. for the necessary office work. Field work completed June,

1901. Special report on the industrial and commercial aspect of the canal lines obtained. **P-99,** 16.

Many maps prepared. Short history of canal projects referred to. **P-99,** 17.

Report submitted, 1901, favoring the Nicaragua route, **P-99,** 13.

Supplementary report of Isthmian Canal Commission, 1899. S. Doc. 123, 57th Cong., 1st sess. The President (Theodore Roosevelt) transmits to Congress a proposal, laid before him by the Isthmian Canal Commission through Sec. of State (John Hay), of the New Panama Canal Co. to sell and dispose of all its rights, property, and unfinished work to the U. S. for $40,000,000. **P-99,** 675.

Correspondence of New Panama Canal Co. with Isthmian Canal Commission, **P-99,** 676.

Outline of rights, etc., offered by the New Panama Canal Co., **P-99,** 676.

Repetition of respective virtues of the Nicaragua and Panama routes. The offer of the New Panama Canal Co. makes the cost of the two routes—for Nicaragua, $189,864,062; Panama, $184,222,358. **P-99,** 679.

Acceptance of terms of New Panama Canal Co. should, in the opinion of the commission, be conditional upon the satisfactory adjustment of concessions desirable from the Republic of Colombia. "The grant must be not for a term of years, but in perpetuity, and a strip of territory from ocean to ocean of sufficient width must be placed under the control of the U. S. In this strip the U. S. must have the right to enforce police regulations, preserve order, protect property rights, and exercise such other powers as are appropriate and necessary. The business relations between the railroad and canal companies and the Colombian Government must also be settled, and the consideration to be paid by the U. S. for the privileges and rights to be exercised in the future must be agreed upon free from all embarrassment with reference to past transactions." **P-99,** 680.

"* * * It must be assumed by the commission that Colombia will exercise the same fairness and liberality if the Panama route is determined upon that have been expected of Nicaragua and Costa Rica should the Nicaragua route be preferred." **P-99,** 680.

"* * * The commission is of the opinion that 'the most practicable and feasible route' for an Isthmian Canal, to be 'under the control, management, and ownership of the United States,' is that known as the Panama route." **P-99,** 681.

1904. Congress authorized the President to purchase at not exceeding $40,000,000 the rights of the New Panama Canal Co.; to acquire from Colombia perpetual control of zone not less than 6 miles wide, and over operation of railroad; additional territory and rights if needful; building of a canal, etc., through a commission; failing satisfactory conclusions concerning the Panama route, negotiations to be conducted for canal by Nicaragua route; the States through which canal shall run to have use of canal and harbors, etc., on special terms to be agreed upon; authorizing commission; appropriating funds; and authorizing Sec. of Treas. to issue bonds to amount of $150,000,000 for this special work. **P-04,** 23.

Treaty with Panama signed 1903. $10,000,000 paid Panama. **P-04,** 36.

Operations continued with French company's employees. Organization of survey parties. **P-04,** 40.

Isthmian Canal Commission No. 2. Committees: Engineering plans, Mr. Harrod, Mr. Burr, Mr. Grunsky, and Mr. Parsons, **P-04,** 37.

Executive, Mr. Parsons, Mr. Grunsky, Admiral Walker, **P-04,** 37.

Engineering, Mr. Burr and Mr. Parsons, **P-04,** 37.

Finance, Mr. Hecker and Mr. Harrod, **P-04,** 37.

Legislature, Mr. Harrod and Mr. Hecker, **P-04,** 37.

Sanitation, Mr. Grunsky and Mr. Burr, **P-04,** 37.

Isthmian Canal Commission likened to a board of directors of a railway. Frequent meetings held. **P-04,** 36, 37.

Temporary head of engineering staff after transfer, Maj. Wm. M. Black, Corps of Engineers, U. S. Army, **P-04,** 36.

Sanitary department, Dr. W. C. Gorgas, colonel, U. S. Army, the chief officer, **P-04,** 37.

Disbursing, Geo. C. Schafer, paymaster, U. S. Navy, **P-04,** 38.

Sec. of War Taft suggests more elastic organization, permitting designating members of the commission to charge of special duties, **P-04,** 13.

First visit of Isthmian Canal Commission No. 2 to Isthmus: Arrived Apr. 1, 1904. Cordial reception from Republic officials, etc. Study made of plans and methods of old company; points of work visited; evident that new and extended surveys and examinations necessary because of increase in modern requirements; advisability of sea-level or lock-level canal to be determined; surveys planned. **P-04,** 38.

"The organization of the department of engineering and construction has been made with two distinct purposes in view. The first of these purposes covered the entire field work, including surveys and investigations necessary for the solution of all problems preliminary to the development of plans for the entire project of a ship canal between the two oceans and the design and construction of waterworks and sewer systems for the cities of Panama and Colon. The second purpose was the formation of the preliminary organization in such a manner as to merge efficiently into the permanent organization ultimately required for

the actual construction of all classes of work embraced in the entire engineering construction within the limits of the Canal Zone." Preliminary work of surveys nearly completed, "so that the studies for the features of the general project can soon be undertaken." The purpose of the Isthmian Canal Commission No. 2 to install and operate considerable number of large steam shovels already purchased in the U. S. Some of the old French plant has been found usable temporarily. Feasibility of excavating the Culebra Cut by the hydraulic method considered. **P-04**, 43.

Law establishing government for the Canal Zone, act Apr. 28, 1904, **P-04**, 31.

Letter of instructions from President Roosevelt to Isthmian Canal Commission No. 2, through Sec. of War Taft, placing Isthmian Canal Commission No. 2 in charge of the government of the zone, giving it the power to legislate, and appointing Maj. Gen. Geo. W. Davis (member) governor of the zone, **P-04**, 31.

Instrument conveying canal properties to the U. S., Apr. 23, 1904, **P-04**, 35.

Letter of President Roosevelt, Oct. 18, 1904, instructing Sec. of War Taft to proceed to Panama to reassure Panama authorities it "is not the purpose of the U. S. to take advantage of the rights conferred upon it by the treaty to interfere with the welfare and prosperity of the State of Panama or of the cities of Colon and Panama," **P-04**, 5.

Executive order, in name of President Roosevelt, Dec. 3, 1904, limiting importations, tariff duties, port control, postal matters, currency, voting of Panama residents in zone, roads, hospital treatment, by Sec. of War Taft. "The truth is that while we have all the attributes of sovereignty necessary in the construction, maintenance, and protection of the canal, the very form in which these attributes are conferred in the treaty seems to preserve the titular sovereignty over the Canal Zone in the Republic of Panama, and as we have conceded to us complete judicial and police power and control over the zone and the two ports at the end of the canal, I see no reason for creating a resentment on the part of the people of the Isthmus by quarreling over that which is dear to them but which to us is of no real moment whatever." Supplementary order, Dec. 6, 1904, clarifying doubts relating to imports. Section XIII of the treaty construed (Jan. 7, 1905) to give free entry of things needed by those engaged on the canal work, etc., but not of things customarily found on sale in the zone and required by those who come from tropical countries, but if the local merchants charge undue prices for these the canal employees may avail themselves of imports for those coming from nontropical limits. **P-04**, 5, 17.

1905-1913. (See pp. 2361-2368 of this Index.)

Isthmian Routes. (See No. 4, p. 2361 of this Index.)

Isthmus, Geology of. (See Geology; see No. 194, p. 2365 of this Index.)

J.

Jails. (See No. 58, p. 2362 of this Index; and Civil Administration.)

Johnson, E. R. (See No. 1, p. 2361 of this Index.)

Judiciary.
Compensation, **P-14**, 581.
Recommendations and suggestions, **P-11**, 498.
Executive order, **P-14**, 589.
Statistics, **P-06**, 71.
System established working admirably, **P-06**, 41.

Jury.
Executive order relating to trial by jury, **P-13**, 631.

Justice and Judiciary. (See No. 57, p. 2362 of this Index.)

K.

Kitchens. (See Commissary; Subsistence; Employees; Labor.)
Articles consumed, **P-12**, 396.
Laborers', **P-07**, 96, pl. 107.
Laborers', Comacho, **P-07**, 88, pls. 105, 106.
Laborers', Gorgona, **P-07**, 88, pl. 106.
Operations, **P-10**, 334; **P-11**, 374; **P-12**, 397, 406; **P-13**, 400-409.
Rations and meals, **P-09**, 230.
Rio Grande, **P-07**, pls. 84, 85, 86, 105, 106.
Statement, **P-09**, 224.

L.

La Boca.

- Town practically owned by the U. S. Instead of being a dangerous plague spot, made into a model camp, with houses in good repair, freshly painted, supplied with electric light, a water system, and good drainage. **P-05,** 42.

La Boca Division. (See No. 135, p. 2364 of this Index.)

- Covers work from Pacific to Miraflores, operation of small machine shop and marine ways for repair of floating equipment. Quarantine delayed work, and so did sickness following. Surveys, soundings, and tidal observations. Old French dredge at work on harbor, deepening and enlarging channel. **P-05,** 115.
- Extends from Pedro Miguel to Panama Harbor. Prior to Aug. 10 under the immediate charge of the engineer at Cristobal. Surveys: Complete system of triangulation established from Pedro Miguel to Naos Island and points surrounding Bay of Panama; topographical surveys made of the lock and dam sites proposed by minority Board of Consulting Engineers; survey of Bay of Panama; many borings at various points; current observations Bay of Panama.
- Repair of plant: Heavy repairs made of floating plant, of dredges, barges, etc. Old French dredge kept at work dredging canal entrance east of Panama; about 1,200,000 c. y. dredged at cost of 12 cents per c. y. Work of division seriously handicapped on account of shortage of labor and material. **P-08,** 88.

Labor, P-04, 13; **P-05,** 9; **P-06,** 5; **P-07,** 139; **P-08,** 247; **P-10,** 305; **P-11,** 354; **P-12,** 377; **P-13,** 372; **P-14,** 270. (See Convicts; Employees; Messes; Quarters; Subsistence; see Nos. 68, 126, 162, 224, pp. 2363, 2364, 2366, of this Index.)

- Accidents and deaths, statistics, **P-07,** 189.
- Act eliminating aliens from operation of 8-hour law, **P-11,** 560, 562.
- Attracted from farms to public works, **P-05,** 54.
- Barracks, Cristobal, **P-09,** 220, pl. 95.
- Brought to Isthmus at Isthmian Canal Commission expense, **P-07,** 140; **P-08,** 248.
- Camps, **P-07,** pl. 104, 110.
- Colored, expensive, **P-05,** 120.
- Commissaries, **P-05,** 8, 48.
- Commissary for, inadvisable, **P-04,** 12.
- Conditions, **P-07,** 78.
- Contract labor, **P-09,** 212; **P-10,** 311; **P-11,** 354; **P-12,** 412; **P-13,** 384.
- Contract vs. hired, **P-07,** 16.
- Cost of, **P-07,** 139.
- Crime statistics, **P-07,** 181.
- Culebra division, **P-07,** 43.
- Demoralization, cause of, **P-05,** 108.
- Department of, organization, chart, **P-07,** pl. 145.
- European more disorderly but superior to West Indian, **P-07,** 78, 163.
- Food, etc., **P-10,** 324; **P-11,** 378; **P-12,** 400; **P-13,** 396. (See Kitchens and messes, below.)
- Food supply, tropical, **P-05,** 46.
- Foreign, consular complaints, **P-07,** 153.
- Hotels for, tropical, **P-05,** 44.
- Houses, **P-07,** pl. 111. (See Houses.)
- Kitchens, etc., **P-07,** 88, 96, pls. 105, 106, 107. (See Food, above.)
- Mess Halls, **P-07,** 96, pls. 107, 108, 109.
- Obtaining, for tropics, **P-04,** 12; **P-05,** 9; **P-07,** 25; **P-08,** 247.
- Obtaining labor from various sources—Jamaica, Porto Rico, Japan, etc., **P-04,** 13; **P-07,** 25.
- Panama Canal conditions against contract work, **P-07,** 18.
- Quarters, **P-07,** pls. 100-120.
- Quarters, tropical, organization, **P-05,** 44, 45.
- Rations, etc., **P-07,** 88, 96; **P-10,** 324; **P-11,** 378; **P-12,** 400; **P-13,** 396.
- Recreation, providing, **P-05,** 8, 55.
- Recruiting of, on zone, prohibited. (See Orders, Executive.)
- Sick, care of, **P-05,** 50.
- Trains for, **P-07,** 96, pl. 127; **P-10,** 322, pl. 65.
- Unskilled, tropical laborers unsatisfactory, **P-06,** 5.

Labor and Quarters. (See Labor above.)

- Has charge of the hiring of all grades of employees and of assigning them to the various departments, of providing and assigning quarters, record of employees; handles directly all hotels and mess houses; has general charge of all buildings on the zone belonging to the Isthmian Canal Commission. **P-05,** 105.
- Supply of efficient unskilled labor a problem. Tropic laborers 25 per cent to 33 per cent efficient only compared with U. S. labor. Eight-hour law applied to this class not deemed advisable, as it would add many millions to cost of canal; not expected by laborers until they arrive and learn of it. Isthmian Canal Commission No. 3 recommends that labor on the Isthmus be excluded from the application of the 8-hour law, contract-labor law, Chinese-exclusion act, or any other law for the protection of U. S. labor at home. **P-05,** 9, 10.
- Tropical labor inefficient and hence expensive. Regular pay, good food, and better overseers already producing more efficiency. **P-05,** 120.
- Branch has charge of hiring of all grades of employees, assigning them to the various departments, assigning them quarters, etc. Directly handles all hotels and mess houses, and has general charge of all buildings on the zone belonging to the Isthmian Canal Commission. Table showing the force in the three departments of construction and engineering, government and sanitation,

and material and supplies, ranging from 9,786 to 16,997. Sources of supply: Barbados, 8,043; Martinique, 1,756; Jamaica, 4,981; coast towns and small islands, 10,254. Spanish laborers very satisfactory, being paid 40 cents silver per hour, as compared with 20 cents to other kinds of labor. Skilled labor obtained through recruiting agencies in the U. S.; improvement in grade being noted; increased wage rate necessary; authorized Dec., 1905, but even then scale not higher than in U. S., making it difficult to obtain class of men needed. Clerical force, obtained through civil service, not altogether satisfactory. Ordinary labor far from efficiency. "The majority work just long enough to get money to supply their actual bodily necessities, with the result that, while we are quartering and caring for twenty-odd thousand of these people, our daily effective force is many thousands less." Preliminary steps taken toward securing large numbers of Spanish laborers direct from the northwestern Provinces of Spain, and also for securing trial shipment of Cantonese Chinese. Upon fixment of lock-level plan, 5,000 to 6,000 additional employees could have been used; delay from their not being available. Eating houses established at various points. Isthmian Canal Commission took charge of hotels, etc., opened for white employees until better arrangements could be made. Year's work of labor and quarters branch satisfactory. Believed that physical stamina of employees can be kept up to a standard equal to that of the U. S. **P–06,** 114.

Bids asked by Isthmian Canal Commission for Chinese labor—2,500 for not less than 2 years, with privilege of increasing number to 15,000. Four bids; the two accepting the terms the lowest. Laborers, 9 to 11 cents an hour. **P–06,** 14.

Impossible to get satisfactory work from tropical negroes. Will not take nourishing food. Spanish labor efficient. White men can stand isthmian climate better than "blacks, who are supposed to be immune from practically everything, but who, as a matter of fact, are subject to almost everything." **P–06,** 5, 6.

Transportation of, amount spent, **P–08,** 249.

Labor, Quarters, and Subsistence. (See Labor above.)

1907. This department charged with securing all skilled and unskilled labor and its assignment; is the custodian of all living quarters; supplies furniture, delivers distilled water and food supplies; polices grounds around camps and quarters; has charge of the lighting of camps and roads; operates the hotels, messes, and kitchens for the accommodations of the employees; keeps service history of each individual employee; records leaves, etc.; authorizes transportation, etc., **P–07,** 24.

Labor supply: Skilled labor recruited in U. S., through agents. Clerks, stenographers, draftsmen, doctors, and nurses secured through civil-service registers. Skilled force, June 30, 1906, approximately 2,500; June 30, 1907, actually 4,404. To increase the force 1,904 men, 3,038 men brought from the U. S. during the year. Unskilled force brought from West Indies and Europe; gained through agents. June 30, 1906, 500 Europeans and 13,625 West Indians. June 30, 1907, 4,317 Europeans and 14,606 West Indians. An average of about 1,500 men per month recruited to keep up the force. June 30, 1907, the increase in the employees was 10,000 over previous year. "Labor problem is still an unsolved one," but efficiency increasing. Always large periodical changes in tropical labor. **P–07,** 25, 26.

Quarters: June 30, 1906, 1,129 houses available for quartering employees of all classes. June 30, 1907, 2,208 were available. Quarters better and more comfortable than ever. Congestion in quarters of laborers has entirely disappeared. **P–07,** 26.

Subsistence: 15 hotels operated for Americans; meals, 30 cents. Hotel Tivoli, Ancon, with superior accommodations, charging more. 18 mess halls for Europeans; day's board, about 40 cents. 23 kitchens for West Indian laborers; day's board, about 30 cents. West Indian laborer employed upon a basis of subsistence as a part of his compensation, because of his careless habits and the probability that he would impair his efficiency by lack of proper nourishment. Nearly a million meals a month served to all classes. Subsistence operations self-sustaining; no profit taken, however. **P–07,** 26, 27.

Commissary: Commissary department of railroad furnishes supplies to hotels, messes, kitchens, etc. Various branch stores. In operation, cold storage and ice plants, laundry, bakery, etc., all at Cristobal. **P–07,** 33, 34.

1908. Organization: Resignation of Jackson Smith. Maj. Carrol A. Devol, quartermaster, U. S. Army, assigned. Duties of the department to be divided. Maj. Devol to have charge of labor and quarters, and division of material and supplies, as a "quartermaster's department." The subsistence features to be consolidated with the commissaries of the Panama R. R., and to be in charge of Maj. Eugene T. Wilson, Artillery Corps, U. S. Army, as a "subsistence department."

Labor: 1,828 men employed in the U. S., as against 3,038 the year before, while the number employed on the Isthmus increased from 2,780 to 3,382. 500 more Europeans and 1,000 more West Indians on the work than at the close of the previous year. 4,150 West Indians and 3,650 Europeans imported. Excess of immigration over emigration, 18,000. "The labor problem may be considered solved."

- Quarters: 700 American families brought; quarters accommodating 250 families recommended for construction. No such congestion for married quarters as existed a year ago. Laborers' quarters ample; increasing tendency to go into the bush or tenements in the towns; doubtful if move is beneficial.
- Subsistence: 20 hotels operated for Americans, 25 mess halls for Europeans, and 31 kitchens for West Indian laborers. Inspection instituted looking toward cleanliness of messes and better food supplies. **P-08**, 23, 24.
- Commissary—Organization: Operated by the subsistence officer of the Isthmian Canal Commission under the direction of the president of the Panama R. R.
- Stores: 13 branch stores, along line; 5 new.
- Work: Supplies ice, meats, bread, pies, cakes, ice cream, and groceries of all kinds, as well as laundry service, to the hotels, messes, and kitchens, and to employees of the Isthmian Canal Commission.
- Sales: $3,736,607.11.
- Equipment: Coffee-roasting, ice-cream, and pie and baking plants added to the main commissary Cristobal.
- Employees: Average, 742. Cost, $430,343.75. **P-08**, 30.

Laboratories. (See No. 108, p. 2363 of this Index.)
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- Recent rise of, geological data, **P-13**, 574.

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Lands, Zone.
- Land agents appointed to care for the U. S. lands, etc. Survey in progress of location of towns and villages. **P-05**, 67.
- Leasing of lands for agricultural uses being encouraged; 121 leases made of this kind. Ever-present market for fresh vegetables, etc. **P-06**, 33.
- Difficult to foresee uses to which land in zone may be put. Within limits of zone 436 sq. m., of which about 73 sq. m. in private ownership and 363 sq. m. owned by U. S.; of latter, 96 sq. m. occupied by canal.
- Large part of U. S. land required for military and naval purposes; not unlikely that additional lands will be required by other departments of U. S. Position of Republic and its two cities with respect to zone makes it necessary in interest of harmony that Spanish laws now in force shall obtain. Rules and regulations for government of zone, made effective subsequent to 58th Congress, should be approved and changes should be authorized to meet new conditions as they arise.
- Under existing law, lands may be leased for not exceeding 25 years, with understanding that cost of improvements shall be reimbursed to lessee in case lands needed for other purposes. Generally the rule that land taken for U. S. purposes never sufficient and must always be extended, and from experience gained in prices agreed upon for lands taken for canal purposes, improvements always expensive. For most part, configuration of ground not suitable for extensive farming; material obstacles tend to hinder agricultural development; perpetual title can not be assured; and Spanish system of taxation must be continued to avoid friction on account of unfair competition with Panamans. Inducements offered not likely to attract Americans. Other occupants are desirable. Town sites already established populated by laborers, a class which should be repatriated after work can no longer be given, and growth of such towns should be discouraged. Greater the

amount of land leased and number of town sites established and occupied, greater will be cost of sanitation and civil government. For several years to come believed that best policy will be to keep all U. S. lands for U. S. purposes. Military force located on Isthmus will be charged with its own sanitation. Reservation of all lands for U. S. use would result, therefore, in minimum costs for these two items.

Zone occupies unique position among outlying possessions of U. S., and on this account requires special treatment. Construction of canal is original purpose, and to this purpose everything within zone subordinate. After completion everything must be subordinated to operation of canal. Assuming that canal built for benefit of commerce of world, nevertheless is military asset to U. S. and condition may arise in which military necessities of U. S. will be paramount. During certain periods operation of canal for commercial purposes, entirely separate and distinct from military; there are times when military necessities predominate. **P-11,** 62.

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Law, Department (Operation.)

1911. By Executive order of the President, Apr. 16, 1910, position of counsel and chief attorney created with specific duties, and filled by appointment of Judge Frank Feuille. Under the order he is legal adviser to Isthmian Canal Commission, chairman, and head of department of civil administration; in addition, he has direction and control of all litigation, as well as supervision and direction of all prosecutions for offenses against law. Executive order, Jan. 8, 1908, created a department of law, charged with general supervision of legal matters pertaining to Isthmian Canal Commission, including acquisition of right of way and adjustment of land damages. Under this order, land questions handled through prosecuting attorney on Isthmus by general counsel in Washington. After resignation of general counsel, Apr. 30, 1909, only such land matters considered by prosecuting attorney as needed immediate attention. Land titles on Isthmus are in unsettled state, and with completion of canal construction in sight it became necessary to adopt some measures looking to adjustment of land situation as soon as possible. Decided, therefore, that all questions affecting lands on Isthmus should be handled by counsel and chief attorney, and with this in view department of law placed under direction of counsel and chief attorney.

Questions affecting lands belonging to Panama R. R. handled by land office of that organization, and those affecting lands owned by Isthmian Canal Commission handled by legal department; and though counsel and chief attorney is also attorney for Panama R. R., deemed advisable to consolidate all land matters on Isthmus. Effected May 1, 1911, under Executive order of Jan. 19, 1911, by creation of land office, to which were transferred all papers, maps, records, and other documents relating to lands owned or controlled by U. S. in zone and lands auxiliary to canal.

Act Feb. 27, 1909, relating to use, control, and ownership of lands in zone, authorizes President to lease land. No leases made under this act, but practice of issuing leases by authority of Sec. of War adopted and continued. By Executive order Oct. 7, 1910, such leases to be executed by officer in charge of land office, with approval of head of department of civil administration.

Aug. 6, 1908, to June 30, 1910, 11 joint commission awards paid by U. S. for lands taken over for canal purposes, amounting to $142,515, and joint commission having failed to agree in 3 claims, they were settled in accordance with findings of umpire for $61,000. During same period 16 tracts of land acquired by U. S. for canal purposes under private agreements with owners for $47,215.74, and 50 claims for damages to crops and improvements settled for $5,087.95. In addition, 68 claims, amounting to $8,796.55, paid between Apr. 8, 1910, and June 30 following on account of fire at Nombre de Dios.

During year island of Margarita in Manzanillo Bay near Colon and one or two other small holdings acquired by payment of $4,250. In addition, 112 claims for damages arising in connection with excavation work, surveys, road building, and other canal activities settled for sum of $4,532.37. Ten additional claims for fire at Nombre de Dios settled for $436.20. 208 claims in area of Lake Gatun, including valleys of Chagres, Gatun, and Trinidad Rivers, adjusted and paid for $46,704.50. $33,964.85 paid to Caribbean Cocoanut Co. by Panama R. R. for damages from cancellation of lease held at Toro Point. Total paid on claims during year, $90,442.92.

Executive order outlining duties of counsel and chief attorney gives to latter equal authority with judges of courts of zone to issue subpoenas for witnesses in criminal cases and to examine witnesses under oath in investigation of offenses against laws of zone. Information in civil case may also be filed by prosecuting attorney, assistant prosecuting attorney, or other counsel specially designated by head of department of civil administration, as well as by counsel and chief attorney. Order contained substantial modification of existing law, providing more expeditious method of prosecuting criminal cases.

Conflicts between agents of Isthmian Canal Commission engaged in canal construction and shipping interests began to arise relative to rights of parties to use of waters. Resulted in enactment of legislation to prevent interference with canal construction, authorizing Isthmian Canal Commission to establish rules and regulations respecting use or passage through canal channel and all other navigable waters, and fully protect such navigable channels from injury or obstruction.

During existence of municipal governments in zone taxes assessed, levied, and collected by municipal authorities for benefit of local treasuries. Municipal governments abolished by Executive order Apr. 15, 1907, and functions of municipal officers vested in district tax collectors, under supervision of collector of revenues. Confusion resulted as to right of forfeiture of property to zone government in default of bidders at tax sales. To remedy existing conditions, Executive order Oct. 4, 1910, abolished office of district tax collector, and powers and duties of this office vested in collector of revenues, to be exercised by him through deputies. Order also provided that property sold for taxes should be forfeited to zone in default of bidders at tax sales.

Counsel and chief attorney calls attention to necessity of compiling, revising, and adding to existing legislation so as to establish simple, complete, correlated, and efficient system for civil government of zone. Administrative laws also in need of revision, so that duties of various departments may be clearly defined and coordinated. Law of civil procedure, criminal code, and law of criminal procedure also need revision. Held in abeyance until policy of U. S. with reference to zone determined. **P-11,** 54-56.

1912. Congressional legislation affecting canal not enacted until after close of fiscal year. Aug. 24 Panama Canal act made effective and sundry civil act approved on same date, making appropriations for current fiscal year, contains legislative provisions affecting canal. In addition, 16 Executive orders having effect of law issued to provide for cases and conditions which had arisen and which necessitated enactment of provisions to cover them.

Attention already called to necessity of a revision of Canal Zone laws, in order that legislation might be brought under one complete correlated system. Head of department of law advocates remedying condition by embracing in one code all Colombian and Panaman laws deemed expedient to keep and repealing the others. Revision of administrative laws also necessary.

Assistant prosecuting attorney handled criminal matters in the zone during the past year; 615 cases disposed of in three circuits; 398 resulted in convictions, 139 in acquittals, 66 in dismissals, and in 12 defendants were fugitives and not arrested. Makes considerable increase in number of criminal cases, due in part to large number of prosecutions for gambling and for violations of navigation laws; increase in idle population probably responsible. Four criminal cases passed upon by supreme court of zone; two resulted in affirmance, in one trial court's finding reversed, and fourth was habeas corpus proceeding brought originally in supreme court.

Cases arise occasionally in which unlawful intrusions made upon public lands; no authority for anyone in zone to submit title of U. S. to judicial ascertainment. If land be needed for canal purposes, intruders ordered to leave; on failure to do so are ejected by police. When lands intruded upon not needed for construction purposes, appeal taken to courts to evict occupants. On this theory several suits instituted on behalf of Isthmian Canal Commission and 225 acres of land between cemetery at Mount Hope and quartermaster's corral at Cristobal recovered for U. S. and Panama R. R. Several disputed land claims pending which might be adjusted amicably if commission were authorized by Congress to agree upon boundary lines with claimants.

Several small tracts acquired from private persons by deed, and claims will not be submitted to joint commission for adjustment. Amount aggregated 979 hectares and consideration $9,318. In addition, 31 quitclaim deeds taken by Panama R. R. from squatters at Toro Point; consideration, $5,578.

295 revocable licenses issued for 315 lots in town sites, calling for annual rental of $2,529.09. $1,536 obtained from monthly licenses covering 27 rooms in houses belonging to Isthmian Canal Commission at Gorgona, and $900 additional for rental of 1 house at same place. **P-12,** 62-64.

1913. In anticipation of inundation of Gatun Lake area, number of towns along line of old Panama R. R. between Gorgona and Gatun cleared of population; as result, administrative district of Gorgona abolished and its territory added to district of Empire for judicial, administrative, and political purposes, by Executive order Sept. 2, 1912. Order also abolished office of senior district judge and reduced number of district judges to 3.

Panama Canal act Aug. 24, 1912, authorized President to declare all land and land under water within zone necessary for construction, maintenance, operation, sanitation, and protection of Panama Canal. Executive order

issued Dec. 5, 1912, directed all land and land under water within limits of zone be taken possession of and to extinguish, by agreement when practicable, all claims and titles of adverse claimants to occupancy. Negotiations pending between U. S. and Panama for exchange of lands known as Las Sabanas, lying contiguous to Panama, in zone, for certain harbor areas in Colon; Executive order Feb. 18, 1913, issued, modifying provisions of order of Dec. 5, 1912, exempting privately owned lands in territory under negotiation from being acquired by U. S. Mar. 19, 1913, order issued protecting from wanton killing or injury birds of zone. Order Mar. 20, 1913, amending order Feb. 5, 1912, collector of revenues authorized to administer upon estates which consisted of personal property only, regardless of value of estates, maximum value previously fixed being $1,000. Under existing law, estates of deceased or insane employees of Isthmian Canal Commission, zone government, and Panama R. R. administered by collector of revenues free of cost. Actions of collector subject to supervision and approval of Circuit Court of First Judicial Circuit of zone.

Complaints that agents of foreign corporations whose financial condition doubtful doing business in zone. Order issued Mar. 20, 1913, requiring foreign corporations or joint-stock companies to file articles of incorporation with collector of revenues for zone, together with information to enable collector of revenues to base conclusion as to solvency of concern. In addition, foreign corporations required to file authorization with collector of revenues to represent them in all suits and legal proceedings in zone, and to pay annual tax of $50. Order has had effect in keeping out undesirable concerns.

Apr. 15, 1913, maritime quarantine regulations for zone and harbors of Panama and Colon in Republic established by order, to take effect upon the date on which Panama Canal is officially and formally opened by President of U. S. Regulations promulgated in advance that shipping interests and public may have information in regard to quarantine requirements of canal and zone.

Prosecution of criminal cases conducted by assistant prosecuting attorney; 621 cases disposed of in 3 circuits; 440 convicted, 111 acquitted, charges against 54 dismissed, and in 7 cases defendants fugitives. One disbarment proceeding brought in supreme court against attorney of zone, and defendant disbarred.

$27,606.50 paid by Isthmian Canal Commission in settlement of claims presented by squatters and occupants of lands. Several tracts acquired from private persons. Quitclaim deeds obtained for U. S. for holdings at Santa Isabel, El Encanto, Victoriano, and Paja. Mar. 31, 1913, all unexpired Isthmian Canal Commission leases for building lots and agricultural property terminated; on that date there were 174 leases, covering 99 hectares of agricultural land and 108 building lots, which would have remained in force until June 30, 1913, had it not been for cancellation.

312 revocable licenses, covering 347 building lots, in force June 30, 1913, calling for annual rental of $2,816.96. **P-13**, 65–67.

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Department created by act 8, Isthmian Canal Commission. Charged with all litigation before courts of special tribunals of the zone, and advises the governor and the commission respecting questions of law arising in the administration. Presents the interests of the U. S. in the courts of Panama. Charged with the duty of negotiating for the purchase of real estate; only 3 cases of latter kind had to be settled on an expropriation basis. Many cases of damages caused by municipal engineers and the department of health settled; one unsatisfied

claim led to examination of all titles on the Isthmus, with the result that it developed all the land belongs either to the U. S. or to Panama R. R. Aug. 16, 1904, penal code enacted and put in force; natives adapted themselves instantly. Zone considered practically free of crime. Gambling suppressed. Immediate trials, avoiding expense and delay. **P-06,** 41.
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Locks and Dams, Operation. (See Locks and Lock Gates, below.)

1906. After determination of canal-level policy, Isthmian Canal Commission No. 3 fixed definitely location on the Atlantic side of 3 sets of locks and a great dam at Gatun, and on the Pacific side of 1 set of locks at Pedro Miguel and 2 sets at La Boca and 2 dams in the vicinity of La Boca, a large one between Sosa Hill and Corozal and a smaller one between Sosa Hill and San Juan Hill, **P-06,** 14.

1907. Department of construction embraces Gatun Locks and Dam, locks and dam at Pedro Miguel, and locks and dam at La Boca; meteorology and river hydraulics. Project embraces 3 flights at Gatun, 2 at La Boca, and 1 lift at Pedro Miguel. Locks in pairs. Usable lengths, 1,000′; widths, 100′. Previous borings have been criticised; 5 test pits each 6′ by 8′ sunk to depths of the lock walls at Gatun, 2 at Pedro Miguel, and 1 at the spillway in Gatun Dam. Satisfactory rock at La Boca. Board of Consulting Engineers (Alfred Noble, F. P. Stearns, and John R. Freeman) examined borings, and reported, May 2, 1907: "We found that all of the locks of the dimensions now proposed will rest upon rock of such a character that should furnish a safe and stable foundation." Subsequent borings made to plat contours of the rock surface, with a view to economical adjustment of locks to sites. Studies begun of locks, gates, and sluices. Method of filling and emptying the locks, and the number and type of gates, decided. Gates in duplicate; miter type, but rolling gate of Ohio River type to be substituted for duplicate set at lower end of each summit lock. Auxiliary pair of gates at the lower end of each flight to be used as cofferdams in emergency. Tentatively determined to adopt swing bridge dam for emergency. Designs of locks and gates under way. **P-07,** 5.
Gatun Locks and Dams: Excavation of lock site begun Sept., 1906; 4 shovels working Mar., 1907; total of 484,362 c. y., p. m., earth and rock removed. 573 acres of site of dam cleared of timber; pile trestle built for rock depositing. Contracts made for two 20″ pipe-line suction dredges. Cross section of dam slightly changed. Excavation of spill-

way begun Apr., 1907; 1 steam shovel at work; 3,832 c. y., p. m., removed and dumped in near vicinity. Topographical survey made of basin of lake to 100′ contour; area of lake found to be 164.23 sq. m. No stone for concrete in immediate vicinity; quarry opened at Porto Bello; contracts made for rock-crushing plant, and for barges for conveying product to Gatun. **P-07**, 6.

Pedro Miguel Locks and Dam: Test pits made; 162,094 c. y., p. m., removed from lock site, considered as part of work on Culebra Cut. **P-07**, 6.

La Boca Locks and Dams: Preparatory work arrangements made for diversion channel, Borings along the lines of the two dams, La Boca-San Juan and Sosa-Corozal. **P-07**, 6.

Meteorology: Three stations operating, at Naos Island, Ancon, and Bas Obispo. Fourth begun at Cristobal. **P-07**, 7.

River hydraulics: Object of this division the collection of data necessary to predict freshets in time to take measures for preservation of property. Also for determining amount of water to be relied on for supplying lakes to exist upon completion of canal. Rain gauge and fluviograph observations at Alhajuela, Gamboa, and Bohio. Gaugings at Trinidad and Gatuncillo started. Arrangements made for discharge measurements of several channels at Gatun. **P-07**, 7.

1908. Limits: Embraces Gatun Locks and Gatun Dam divisions, the Pacific division of locks and dams, and the division of meteorology and river hydraulics.

Locks: Locks in pairs. Dimensions increased to make locks 110′ wide, usable length 1,000′, in response to ideas of General Board of the Navy; modification approved by the President Jan. 15, 1908. Designs for locks in preparation.

Dams: Steps taken to build Sosa-Corozal Dam; trestles failed; examination of foundation area revealed unctuous blue clay instead of the stiff clay reported by the Board of Consulting Engineers, 1906. Careful examination of canal route made from Pedro Miguel to Pacific by wash and diamond drill borings and test pits to ascertain if a more suitable place for the locks and dams, originally proposed for La Boca and Pedro Miguel, could be found. One lock at Pedro Miguel and two at Miraflores recommended (dams of lower height, less length, resting on rock could be more easily constructed, and works would be under better geographical protection in war); change approved by the President Dec. 19, 1907. **P-08**, 8, 9.

Gatun Locks; borings: Disclosed presence of ground water, under pressure; small. "There is no question that the various materials will bear the greatest loads that will be transmitted to them by the lock walls, if provision is made to prevent the underground flow of water through the softer materials on which part of the walls will rest." Curtain walls to be built to prevent access of the ground water to the foundations. (See special report of C. M. Saville, assistant engineer, on Gatun Dam investigations, **P-08**, 127-196.)

Lock excavation: Nine shovels on work. Nearly 1,800,000 c. y. removed (190,013 c. y. being placed on the south toe of the dam).

Drainage: By gravity; pumping plant being installed.

Stone for concrete: To be procured from Porto Bello, and preparatory work being done there.

Sand for concrete: As the result of searches, etc., deposits in vicinity of Nombre de Dios selected. **P-08**, 9, 10.

Gatun Dam; foundation investigations: Test pits dug and borings made. Examination of spillway reveals rock of sufficient strength to bear safely any of the loads to be placed upon it; what underground flow there is to be cut off by means of curtain walls. Studies show top layer of dam site to be fine sand with a large proportion of clay intermixed, for about 80′; next comes, for about 100′, a thick marine deposit of blue clay (impervious material); under this and directly overlying the rock is a deposit, up to 20′ thick, of small bowlders and gravel consolidated. What seepage occurs is in top stratum; proposed to cut it off by sheet piling projecting up into the core of the dam and down into the impervious layer. "The material encountered is of such character as to be amply strong for supporting the proposed structure." Materials for dam construction can be procured readily from vicinity, and sufficiently. **P-08**, 11.

Experimental dams: Two built with dimensions on a scale of 1″ to 1′. Tests for seepage, etc., showed not only the suitability of the available material, but also that a stable and water-tight dam could be built by hydraulic methods. (See report of Assistant Engineer C. M. Saville. Appendix E. **P-08**, 127-196.

Operations: 918,920 c. y. removed from spillway (this channel 300′ wide with a flare to 500′ on the upstream side, and it was decided to maintain the elevation of its bottom at the south end at 10′ above sea level, so as to preserve as thick a layer as possible of argillaceous sandstone over the conglomerate). The fill at the south toe was extended across the French canal; in this toe 36,669 c. y. of Bas Obispo rock were placed, and 329,257 c. y. from the spillway and the lock site. Trestle built along a portion of the north toe of the dam; 2 lines of sheet piling driven across Chagres River to form cofferdams prior to pumping area dry. Old village of Gatun moved. **P-08**, 11, 12.

Pedro Miguel Lock and Dam; operations: Culebra division excavated the lock site down to reference 40, removing 1,071,696 c. y. (included in total yardage of Culebra division). Locks and dams division began work June, 1908, installing 1 shovel, and constructing trackage. 7,498 c. y. moved from lock site.

Lock and dam plans: Lock to be connected to the rock portion of an adjacent hill by prolonging the east wing wall. West dam will be of earth, and will be 1,400′ long; top elevation to be 107, and width 40′ with side slopes of 4 on 1. Width will be increased, as it will form a convenient dump for the Culebra division. Maximum pressure will be due to a head of 40′. P-08, 12.

Miraflores Locks and Dams; lock foundations: Tests show foundations of ample strength; hard limestone at upper part of site, sandstone at lower end; no variation in formation like those at Gatun.

Lock construction: Site cleared; 2 steam shovels installed Jan., 1908; additions thereafter. Total of 8 shovels assigned to division. 341,786 c. y. removed, nearly 300,000 c. y. being from prism of the locks. Excavated material deposited on either side to be used as foundations for the erecting plant. Pit drained.

Dam foundations: Good.

Dams: Concrete dam from locks to Miraflores Hill, to be 750′ long. West dam to be of earth, 2,300′ long.

Diversions: Cocoli River diversion under way; channel being cut through the hills 1½ miles west of the lock site, a dam required to force stream through this diversion; 73,592 c. y. being removed.

Concrete material: Sosa Hill quarry selected. Sand located at Chame (about 20 miles west of La Boca), in large quantities. P-08, 12, 13.

River hydraulics: Work of previous year continued. Flood-warning station established at Vigia.

Meteorology: 3 first-class and 3 second-class meteorological and 13 rainfall stations established. Fog observations begun. Tidal measurement work transferred to this division. Seismograph station under way. P-08, 13.

1909-1913. (See Atlantic and Pacific divisions, and Fifth division.)

1914. Gatun Locks: As noted in last report, concrete of locks assigned to Atlantic division finished June 14, 1913, with exception of lamp-post bases, bases for snubbing buttons and mooring posts, stairway parapets, and closing of openings left for construction purposes. During year 525 c. y. concrete laid in locks structure; in construction of control house, 94 c. y., and 9,785 c. y. in connection with installation of machinery. Mixers ceased Aug. 16, 1913. Cableways handled 4,111 c. y. concrete and were utilized for transfer of material across locks after removal of bridges used by contractors in erection of gates. Amount of concrete laid in Gatun Locks, exclusive of construction of control house, from beginning of work to close of fiscal year, 2,067,731 c. y. at an average cost of $7.2122 per c. y. No rock or sand handled by unloading cableways during year, but they were used for transferring material from stock piles to tunnel hoppers and for unloading coal for use on west side of locks. Back filling of side walls continued until Dec. 19, 1913. Amount placed during year, 91,576 c. y. Total material used for back fill to June 30, 1914, 2,119,406 c. y. placed behind side walls, and total of 113,163 c. y. placed in center wall. Teams and scrapers, locomotive cranes, and hand labor used to bring back fill to final grade. Concrete paving of slope between locks and Panama R. R. completed. Lamp-posts, snubbing buttons, and mooring posts completed. Construction of control house, begun Apr., 1913, continued by forces of Atlantic division until Oct. 15, 1913, when it was taken over by first division with other unfinished work in Atlantic division. Completed by close of fiscal year, with exception of door and window frames.

Gatun Spillway: Completing fill of openings of valves in body of dam, raising piers to full height, setting valves, and completing bridge. Structure finally finished Oct., 1913. 7,047 c. y. concrete laid, making total concrete placed in structure 231,179 c. y., at an average cost of $7.5273 per c. y. Steps on either side and back fill in connection with them completed by May, 1914.

Gatun Dam: Placing material on portions east and west of spillway to bring dam to full height, bringing slopes generally to final grade, completing fill around and over core wall connecting dam with locks, paving upstream slope, and laying such permanent tracks as advisable to maintain order to make quick repairs in case of necessity. Two steam shovels at work until Mar., 1914, borrowing material from north of dam, and in grading and completion of fill; 314,160 c. y. handled. Paving upstream slope, as outlined in last report, completed Aug., 1913, and 9,860 c. y. large riprap rock from Sosa Hill and from excavation for dry dock at Balboa used. Total large and crushed rock used for paving, 94,330 c. y. Permanent tracks 5,780′ in length laid. Observations for settlement continued. Seepage from dam negligible. At close of rainy season two small streams found issuing from north toe in west portion of dam, but with advance of dry season these ceased. No seepage of any kind apparent in east portion of dam.

Pedro Miguel Locks: Masonry construction carried on at these locks consisted of lamp-post bases, bases for snubbing buttons and posts, stairway wells, and the control house. Concrete laid in lock structure, 1,087 c. y.; in construction of control house, 592 c. y.; and 10,961 c. y. in connection with installation of machinery. As machinery and wiring not all installed, additional concrete required. Total concrete laid at Pedro Miguel Locks, from beginning of work to close of year, 928,326 c. y., and the cost was $5.6575 per c. y. Work on control house begun May, 1913; completed by close of year, with exception of doors, windows, and plumbing. Back filling of side walls completed Mar., 1914, and filling of center wall Feb., 1914. During year 27,750 c. y. placed behind side walls and 5,619 c. y. in center wall. Total material used for back fill to June 30, 1914, 834,288 c. y. placed behind side walls, at a cost of $0.4131 per c. y., and 220,768 c. y. placed in center wall, at cost of $0.4777 per c. y.

Miraflores Locks: At close of previous year concrete of locks proper completed, except lamp-post bases, bases for snubbing buttons and mooring posts, parapets around the stairways, and nosing at end of south-approach pier. During year 2,844 c. y. concrete laid in locks structure; in construction of control house, 949 c. y.; and 18,241 c. y. in connection with installation of machinery. Additional concrete remained to be placed, as installation of machinery and wiring not completed. Building lamp-post bases on southeast wing wall interrupted by necessity of transferring sand operations to Miraflores. Concrete laid in Miraflores Locks from beginning of work to close of year was 1,507,794 c. y. at cost of $5.1696 per c. y. Total concrete laid in Pacific Locks at close of year, 2,436,120 c. y., at cost of $5.3555 per c. y. Back filling lock walls at Miraflores continued. Back filling of side walls completed May, 1914, and filling of center wall Mar., 1914. During year 360,198 c. y. placed behind side walls and 92,244 c. y. in center wall. Total back fill to June 30, 1914, 2,366,252 c. y. placed behind side walls, at cost of $0.3855 per c. y., and 249,457 c. y. placed in center wall at cost of $0.5846 per c. y.

Miraflores Dam and Spillway: During year total concrete laid in spillway 10,112 c. y., of which 9,570 c. y. were plain concrete and 542 c. y. reinforced concrete. Total concrete laid in spillway to June 30, 1914, 74,254 c. y., at cost of $6.2160 per c. y. Last concrete laid Feb., 1914. Dry filling on west dam completed Feb., 1914. During year 98,424 c. y. placed in this dam. Total dry fill placed in dam since beginning of work, 1,758,423 c. y., at cost of $0.4582 per c. y. Design, construction, and inspection of lock gates, chain fenders, emergency dams, operating machinery, and electrical installations continued in charge of Col. H. F. Hodges, U. S. Army, as assistant chief engineer until Apr. 1, 1914, and subsequently as engineer of maintenance.

Lock gates: Construction and erection of gates under contract continued and completed in accordance with supplemental agreement of Jan. 14, 1913. At Gatun all gates for west flight completed Sept. 24, 1913; all gates for east flight Dec. 30, 1913. At Pedro Miguel all gates for east lock completed Sept. 30, 1913, and for west lock Dec. 30, 1913. At Miraflores gates for west flight completed Sept. 30. 1913, and for east flight Jan. 10, 1914. All gates completed within time specified in supplemental contract, time at Miraflores being anticipated by about 2 months. Original contract provided that contractor should paint gates with 2 coats of red lead, at his expense, and with third coat of some other pigment to be furnished by the Isthmian Canal Commission, applied to gates at contractor's cost. Agreement modified and at Gatun arrangement made for additional coat, making 2 of red lead and 2 others, instead of 1. Additional coats consisted, 1 of U. S. Navy anticorrosive and 1 of antifouling paint, and applied to those parts of gates in lower locks constantly under water. On remaining gates at Gatun 2 coats of equal parts of graphite and red lead applied. Intended that no red lead should be used at Pedro Miguel except for upper guard gates, protection to consist of 3 coats of damp-proof paint. At Miraflores gates in lower lock from elevation −6 to bottom to be given 2 coats of red lead, followed by 1 coat of anticorrosive and 1 coat of antifouling paint. All other gates to be given 3 coats of proprietary paint consisting of a hydrocarbon mixture. On account of delay in receipt of damp-proof paints intended for use on Pedro Miguel gates, some of these painted with hydrocarbon paint from Miraflores and, conversely, a few of Miraflores gates painted with damp-proof paint. In all of these cases the third and fourth coats were applied by Isthmian Canal Commission forces. Due to impurities in water of Gatun Lake, none of paints, except bitumastic, which was applied directly to metal on small sections of several of the gates at Gatun, has proved satisfactory, and paint on those parts constantly under water in very poor condition. Action of gates in service entirely satisfactory; leakage at quoin and miter posts small. Cost of gates complete, $6,471,806.99, of which $5,632,942.38 paid under contract, and balance of $838,864.41 for inspection, painting, recess covers, fixed steel, special tracks, and services furnished the contractor.

Gate machines: All parts for mechanical and electrical installation of machines for operating miter gates emplaced. Forty machines required at Gatun completed Feb. 28, 1914, 24 machines at Pedro Miguel on Mar. 28, 1914, and 28 machines at Miraflores on May 28, 1914. Tests conducted to determine conditions under which most satisfactory operation might be obtained, and results show advisability of reducing duty of motor by starting one gate ahead of the other by interval of 20 seconds. Benefit derived, with only 1 gate operating; when gates are near mitering position entire area of chamber is available for storage of water displaced. Cost of miter gate moving machines complete, $822,410.03, of which $704,744.78 expended under the contract, and balance for installation.

Miter gate forcing machines: With the material of miter gate forcing machines on hand, erection progressed with completion of the gates. Twenty machines required at Gatun completed Feb. 14, 1914; 12 at Pedro Miguel completed Mar. 27, 1914; and 14 at Miraflores, Mar. 26, 1914. No special tests conducted. Total cost of machines, $57,200.16; of which $40,225.88 expended under contract and balance for installation. Machinery for operating handrails on gates installed complete; 36 machines at Gatun, 20 at Pedro Miguel, and 24 at Miraflores. Operation satisfactory. Total expended, $29,652.32, of which $17,078.58 under the contract and balance for installation. Installation of pumps for unwatering gates completed; 40 pumps at Gatun, 24 at Pedro Miguel, and 28 at Miraflores. Total expended, $28,516.31, of which $18,979.98 paid out under contract. Installation of electrical appliances for operating various gate machines completed. Total expended, $207,653.42; of which $132,326 paid out under contract.

Rising stem valves: Placing of valves, stems, roller trains, and crossheads remaining to be done at close of last year completed, and 116 machines required for operation erected and electrical installation completed. Of the machines placed during year, 5 were at Gatun and 28 at Miraflores; making total of 56 at Gatun, 24 at Pedro Miguel, and 36 at Miraflores. Mechanical and electrical work in connection with installation completed at Gatun Feb. 12, 1914; at Pedro Miguel on Mar. 30, 1914; and at Miraflores on Mar. 30, 1914.

Guard valves: At end of year all guard valves and machines erected in place at all locks except Miraflores. Six at Gatun completed Apr. 25, 1914; 6 at Pedro Miguel June 29, 1914; and those at Miraflores were 62 per cent completed. Tests made of guard valves showed machines would not operate satisfactorily as originally designed; changes necessary. Amount expended on rising stem and guard valves and their machines to close of year, $1,506,735.59, of which $1,127,725.38 paid under contract.

Auxiliary culvert valves: Mechanical and electrical work in connection with installation of these completed; 4 machines installed at Gatun and completed on Mar. 10, 1914; 4 at Pedro Miguel completed Mar. 5, 1914; and 4 at Miraflores completed Mar. 31, 1914. Cost in place, $22,805.80, of which $16,062.84 paid under contract.

Cylindrical-valve machines: Setting of all cylindrical valves completed during previous year and 41.6 per cent of electrical work finished. Total cost for machines, $228,222.04, of which $161,290.79 in payment of contracts for furnishing material. Remaining electrical work completed on 60 at Gatun, Mar. 30, 1914; on 20 at Pedro Miguel, Jan. 27, 1914; and on 40 at Miraflores, Feb. 27, 1914.

Chain-fender machines: After tests completed on 2 sample chain-fender machines, arrangements made to order balance. Of 16 at Gatun, mechanical work on 14 completed, with exception of chains; of 16 at Pedro Miguel, mechanical work on 7 completed, with exception of chains; and at Miraflores, of 16, mechanical work on 1 completed, with exception of chains. Work in progress on all the units, with exception of 4 lower ones at Miraflores. Electrical work progressed with mechanical work. Manufacture of chain for fenders progressed rather slowly, but orders placed for all chains required with one exception, before close of year. Total expended thus far, $830,726.89; of which $661,140.30 for payments under contract for delivery of the material, and $169,586.59 for erection. Cost of inspecting lock-operating machinery to June 30, 1914, $167,926.06.

Spillway gates: Gates placed by construction divisions in connection with building spillway dams. Mechanical equipment and electrical installation completed on 14 machines at Gatun, Dec. 18, 1913. At Miraflores mechanical work completed on 8 machines on Oct. 13, 1913, and electrical work on June 5, 1914. Gates at Gatun have all been operated satisfactorily under full head, controlled from switchboard in hydroelectric station. Tests of Miraflores gates indicated defects in mechanical work, necessitating overhauling and correction. Changes not completed at close of year. Total expended, $337,529.11, of which $236,045.26 under contract.

Towing-track material: All towing-track material purchased under original contract delivered previous to June 30, 1913. Tests with locomotives brought out fact that it was necessary to provide additional rack sections at top and bottom of inclines at locks, and 606 linear feet of additional rack sections made at Balboa shops. At Gatun Locks 1,182 linear feet of rack section laid, 3,438 linear feet concreted in, and total of 4,082 linear feet completed; making total completed to date 22,185 linear feet. At Pedro Miguel Locks 1,518 linear feet of track laid, 3,901 linear feet concreted in; making total of 13,696 linear feet completed to date. At Miraflores Locks 4,007 linear feet laid, 8,160 linear feet concreted in; making 9,104 linear feet completed during year, or total to date of 18,144 linear feet. Of total to be completed, 54,365 linear feet, 99.3 per cent completed at close of year. Conductor-slot material, consisting of steel and copper conductor rails, insulators, brackets, and cover plates, laid, and during year 12,485 linear feet completed, or complete total to date at Gatun Locks of 45,084 linear feet; at Pedro Miguel 21,760 linear feet during year, or total to date of 36,292 linear feet; and at Miraflores 22,232 linear feet during year, or total to date of 28,162 linear feet. For the conductors copper tee rails used for all towing tracks, inclines, and crossovers, steel conductors being used on return track. Installation of single and double crossovers and turnouts completed during year at all locks. Total cost of all towing-track material installed, $1,182,044.06, of which $767,173.93 expended under original contract.

Towing locomotives: As noted in last report, contract entered into with General Electric Co. for furnishing 40 towing locomotives of their design and manufacture, first locomotive to be delivered by Jan. 15, 1914, and 4 locomotives each month thereafter. Twenty-one locomotives delivered and in operation. Total cost under contract, $527,015; $301,859.21 expended on contract and $22,329.40 for erection and alterations. Tests made by actual service not sufficient to warrant announcement they are satisfactory.

Illumination of locks: Exterior lighting of locks described in previous report. Exterior lighting circuits all locks completed except for 5 posts at Miraflores, where erection of posts delayed by sand operations transferred to this point from Balboa to allow for construction of terminal docks. Installed at Gatun 206 standards, 116 single arm and 90 double arm; at Pedro Miguel, 130 standards, 80 single arm and 50 double arm; at Miraflores, 163 standards, 96 single arm and 67 double arm. Suitable sockets, with lights, installed for illuminating operating tunnels and valve wells. Total expended to June 30, 1914, on electrical lighting equipment of locks, $126,234.52.

Remote control: General Electric Co. awarded contract for furnishing lock-control switchboards for Gatun, Pedro Miguel, and Miraflores Locks. Original specifications of Isthmian Canal Commission departed from as to general construction of board and also with regard to method of accomplishing required interlocking of control switches. Detail design of board left entirely to contractor, work being subject to approval of Isthmian Canal Commission's inspector in U. S. Switchboards located on second floor of control houses and interlocking racks on mezzanine floor. Boards designed to represent locks in miniature, all machines being represented by individual control switches, and wherever important for operator to know exact position of machines being controlled, indicators provided which operate in synchronism with machines in lock wall tunnels. With exception of cylindrical valve, auxiliary culvert valve, and miter forcing machines, operator provided with definite information with regard to exact position of valve or machine being operated by means of synchronous indicators electrically connected with transmitting devices mechanically connected with large machines in lock tunnels. Operation of cylindrical valve, auxiliary culvert valve, and miter forcing devices indicated by use of red and green lamps on control board. Arrangement also made on switchboard by which water levels in lock chambers indicated. Control board completed at Gatun May 9, 1914; at Pedro Miguel June 26, 1914; and at Miraflores June 25, 1914. Switchboards of all locks satisfactorily used for remote control. Total cost of lock-control switchboards, $108,079.50, of which $73,693.33 paid under contract.

Hydroelectric plant: Erection of hydroelectric station continued under Atlantic division until Sept. 8, 1913, when work transferred to building division of quartermaster's department. With exception of doors and some carpenter work, building completed at close of year. Installation of equipment continued; turned over to operating force June 18, 1914; plant took over load from Gatun steam plant July 13, 1914. Expended on installation of machinery, $300,355.60. In connection with power-transmission system, underground duct lines constructed from hydroelectric power house at Gatun to locks and to transformer substation at the point, and from Miraflores transformer substation to Pedro Miguel and Miraflores Locks. As noted in previous report, decided to install for transmission line overhead system of 44,000 volts, extending from Balboa to Cristobal, and connecting existing Miraflores steam-power station with Gatun hydroelectric station, that they may be operated separately or in parallel. Four substations provided, located at Cristobal, Gatun, Miraflores, and Balboa. Excavation for Gatun substation begun Nov. 26, 1913, and steelwork, furnished and erected under contract, completed Feb. 19, 1914. Installation of electrical equipment of building governed by progress made in building construction, and at close of year 37 per cent completed. Total expended on building $145,717.92 and on installation of machinery $40,818.11. Cristobal substation installed for purpose of furnishing power required by coal-handling plant, Mount Hope pumping plant, and miscellaneous requirements in vicinity of Cristobal. Excavation for this structure begun Mar. 4, 1914, and erection of steelwork under contract completed May 6, 1914. Amount expended on building $111,858.01 and on electrical installation $8,557.96. Miraflores substation being installed for purpose of caring for power requirements of Miraflores and Pedro Miguel Locks, and also for purpose of serving as step-up transformer station for Miraflores steam plant. Foundation work commenced Oct. 29, 1913, and steelwork under contract completed Mar. 9, 1914. Electrical equipment 22 per cent completed. Amount expended thus far, $155,532.20, of which $103,509.04 for building construction and $52,023.16 for electrical installation. Balboa substation located for purpose of supplying power to Balboa shops, air-compressor plant, dry-dock pumping plant, coal-handling plant, and Ancon pumping plant, as well as other local purposes. Work begun on this substation Apr. 27, 1914, and steelwork erected under contract completed June 27, 1914. Four per cent of electrical equipment installed. Total expended thus far, $49,173.84, of which $45,565.12 for building construction and $3,608.72 for electrical installation. To supply power to power house of Darien wireless station, being constructed by Isthmian Canal Commission for Navy Department, arrangements made to install small substation of 400-kilowatt capacity, tapping transmission line and stepping voltage down to 440 volts. Change in location of pumping plant from Miraflores to Gamboa necessitated installation of substation at this location. To supply necessary power in connection with pumping plant arrangements made for installation of two 500-kilowatt power transformers and necessary equipment for stepping 44,000-volt transmission line pressure down to 2,200 volts.

High-power transmission line: Under contract of Mar. 31, 1913, 794 double-track span bridges and 20 single-track span bridges to be delivered on Isthmus. All erected with exception of 5 special towers, required at Cristobal and Balboa terminals and 1 bridge at Cristobal. Purchased and received for transmission line, 1,562,208′ of 2/0 Brown & Sharpe gauge stranded copper and 512,065′ of five-sixteenths inch copper-clad wire. At close of year 1,408,443′ of 2/0 conductor cable erected. Total expended on transmission line, $1,014,383.20, of which $701,222.62 covered by contracts.

Cables: Total cable on order, received and installed to end of year, 2,659,403′, of which 1,531,528′ lead sheathed and 1,127,875′ rubber covered, double-braid wire and cable. At close of year 1,462,684′ lead-covered cable pulled into ducts and 911,816′ rubber-covered used for conductor-slot feeds, control connections, etc.

Telephone system: Elaborate system of telephone communication designed for operation of locks and contract awarded for complete equipment. To consist of 3 subdivisions: First, for control of vessels passing through locks; second, upkeep and maintenance work in lock tunnels; and third, local public service.

Emergency dams: Dams at Gatun completed before close of last fiscal year, but final acceptance tests not finished. Two dams at Gatun accepted and dams at Pedro Miguel and Miraflores finished and accepted, the first at Pedro Miguel Sept. 16, 1913, and second Oct. 17, 1913; at Miraflores the first completed and accepted Jan. 14, 1914, and second Feb. 7, 1914. Test made at Gatun May, 1914; dam swung, girders and gates lowered, and pipes driven to close spaces between ends of gates. Upper lock then filled to lake level, upper guard gates and upper operating gates opened, and intermediate and lower gates of lock closed. Upper lock emptied through culverts until water level was below guard-gate sill. This brought full head of 47¾′ on emergency dam; leakage, 950 cubic feet per second; no dangerous current in lock; would have been easy to close any of lower gates in face of stream. Another purpose of test to determine whether dam could be used in lieu of caisson for unwatering locks to permit access to gates for painting, but leakage too great. Experiments being made to devise means of stopping flow. Total expended for emergency dams, $2,206,984.67, of which $1,958,-329.90 covered by contract for delivery of material and its erection.

Floating caissons: Description of caissons for closing entrance to locks, including pumping plant for unwatering lock chambers, given in last report. Bids invited May 21, 1913; 2 bidders, the lowest bidder offering to construct 2 caissons and deliver them at Balboa for $648,300; price for 1, $330,760. Contract entered into for 1 caisson Aug. 22, 1913.

Pontoon bridge: To maintain communication across canal with west side, finally decided to construct pontoon bridge at Paraiso for Panama R. R. Constructed at expense of Panama R. R. Co., but design and construction undertaken by Isthmian Canal Commission. Approaches and abutments built under direction of A. S. Zinn, resident engineer; pontoon and superstructure by dredging division under W. G. Comber; track work by Panama R. R. Co.; and operating machinery by first division, O. C. E. Bridge revolves about pivot at one point, similar to pontoon bridges successfully operated for many years on upper Mississippi. Pontoon is 378′ long over all, 55′ wide, and 6′ 3″ deep at center line. Base of rail 33′ above bottom of barge, or 30′ above water level. Apron girders 64′ long, resting on hinged supports at both ends, and consist of spare lock gate parts. Arrangement is made at each end of girder for automatically providing for variation of 6′ in water level. When bridge is turned, girders lifted clear of concrete piers by electrically driven mechanism and temporarily supported by blocking on ends of barge. Bridge revolved by means of 1″ anchor chain fastened at each bank, which passes around electrically driven wildcat on deck of pontoon. Mechanism for lifting apron girders, turning bridge, and operating rail lift, rail latches, and main latch at pier, operated from central panel. Total cost, $218,331.78.

Operation of locks: Lockages during year gave opportunity to try out locks and machinery. First one at Gatun, Sept. 26, 1913, when tug "Gatun" put through, followed on Oct. 14, 1913, when part of dredging equipment locked through Pacific Locks to lake level. From these dates craft belonging to Panama Canal passed back and forth, in addition to tows instituted for handling freight from Balboa terminals to Colon and Cristobal for Panama R. R. To try out towing locomotives, Panama R. R. steamers "Allianca" and "Ancon" locked through Gatun Locks and returned, and through courtesy of agent of W. R. Grace & Co. the "Santa Clara" locked through Pacific Locks and returned. Operation developed facts in regard to action of flowing water not anticipated. Gates of upper locks of each flight and of Pedro Miguel Locks duplicated. Upper pair called guard gates and lower pair of the upper two the lock gates. At lower end of locks the upper pair called safety gates and lower pair lock gates. Space between guard gates and lock gates regulated by auxiliary culvert, while space between safety gates and lower gates regulated by tee culvert. When water in upper lock is low and valves are open there is sudden drop of water level in forebay. More noticeable at Pedro Miguel, where canal above forebay is narrow, than at Gatun and Miraflores, where forebay opens immediately into lake. Drop faster than can be followed by water in space between guard and upper gates, and result is reverse head on guard gates, causing them to open at miter. Reverse lasts but short time. In first lockages tee culvert regulating space between lower safety gates in free communication with side wall culvert near lower end, but about lower valves. When upper valves were raised water in space between these gates rose faster than in lock; consequently there was reverse pressure on safety gates, causing them to open at miter, pressure being sufficient to compress springs in gate-maneuvering struts. Due to possible danger of crippling moving apparatus by such reverse stress, valves in tee culvert partly closed, choking communication between side-wall culvert and space between gates. Experimenting, a degree of closure reached which caused water in space between culverts to lag behind water in lock when filling, and at same time to fall more rapidly when emptying. In this way positive pressure always kept against safety gates. With use of both side and center wall culverts, as rapidity with which water level in lock changes is increased, different adjustment necessary. When valves in side culvert are raised and water enters lock flow of water greater through those openings in laterals nearest middle wall than through those nearer side culvert. As water rises in greatest volume next to middle wall, results a slight slope of surface toward side wall. When both side and middle culverts used no such action noticeable. First gush of water from side culverts appears to come from highest laterals and then successively from the others. Can not be stated that discharge greatest from any one of laterals. In filling or emptying small canal lock water levels approach eath other with rapidity depending upon square root of diminishing head. Toward end of operation change in level becomes slower, and flow of water supposed to cease either just before or at equalization of levels. Frequently the gates are opened with slight head against them to avoid loss of time involved in waiting for head to vanish entirely. In filling or emptying locks of Panama Canal there is noticeable overtravel of water, so that water in chamber which is filled rises slightly higher than level in chamber from which water drawn, and gates separating chambers become subjected to reverse head. At Pedro Miguel noticed that water rises from 0.3 to 0.6 of a foot higher than water in forebay, tending to throw upper gates open. Difference in head of short duration, but very noticeable; taken as indication of instant when apparatus for opening gates should be put in motion. This acts as safety device to motors which operate gates. In report of Isthmian Canal Commission for 1911 is described method used for overcoming differences in pressure on lower gates at lower lock, Miraflores and Gatun, due to difference in density of water above and below gates, in consequence of which culverts were turned up at outer end to reduce pressure to manageable quantity. Possible that overtravel of water from the emptying lock into tailbay may result in continuing flow of fresh water through culvert beyond point at which in theory it should cease; therefore, in obviating danger of resultant pressure. No trouble experienced from resulting pressure against lower gates. Difference in density of water above and below gates is noticeable in another way. When lower gates are opened fresh water rushes out with considerable velocity on surface of salt water below, and there is corresponding rush of salt water along lower strata. This current continues for considerable time and has noticeable effect on vessels leaving lock, sheering them away from middle wall as soon as they pass angle of side wall. Slope given to water in lock by use of side culverts already been noted. Same effect noted during filling of lowest lock with fresh water when lower gates have been left open long enough to insure salt water filling lock. Slope is from middle wall so that ship moves to side wall and towing locomotives unable to hold large vessel central in lower lock during entire process of filling when side culvert only used. As noted in previous reports, in formula for filling and emptying locks coefficient of flow C, used to determine real velocity, assumed at 0.65, this being slightly more favorable than experience at other locks has shown to be readily obtainable, but nature of design and construction warranted assumption. From experiments made at Pedro Miguel when lake level was at reference 84.8 and water in lock at reference 50.9, value of C for side culvert, with both valves open, determined to be 0.886, much more favorable than anticipated. Similar observations, using only one valve, made both at Pedro Miguel and upper lock at Gatun as check, and value of C found to be 1.177 and 1.272 at two locations, respectively. Value of coefficient for emptying lock at Pedro Miguel somewhat less favorable than for filling coefficient C for side culvert being found to be 0.804 when both valves used. At Gatun and Miraflores, where culvert turned up at discharge, coefficient of flow for emptying lower lock about 8 per cent less than through level discharge at Pedro Miguel. When middle wall culvert used in combination with side culvert time of operation greatly reduced. Pedro Miguel Lock can be filled or emptied in about 8 minutes without causing too great a disturbance in the chamber. Observations not yet made with middle culverts at Gatun and Miraflores. **P-14,** 6–21.

Locks and Lock Gates. (See above.)

1899. Study of locks for Nicaragua and Panama routes. By S. H. Woodward. Appendix A. Report of Isthmian Canal Commission No. 1. **P-99,** 179–196.

General description of the methods of calculation of the stresses and stability of the walls, floors, and various other parts of the locks, and memoranda of the assumptions made, the stresses computed, the dimensions determined, and the estimates of cost of the locks designed for the two routes. Designs and computations made under the direction of the Isthmian Canal Commission No. 1 committee on locks. General drawings show the principal features of the locks; pls. 24, 25, 64, 65, 66. Twin locks were designed in all cases. Estimates made of the cost of building single-lock system, but with provision that second lock could be added later by simply building a floor and one side wall. General dimensions of locks: Clear length, 740′; clear width, 84′; depth, 35′. Total length of lock masonry to depend upon the kind, number, and arrangement of the gates, as well as upon the clear length required. Lateral dimensions of the lock walls dependent upon the height of the walls and upon local conditions.

Lock gates: Exhaustive study of steel lock gates had been made by the U. S. Board of Engineers on Deep Waterways,[1] in their investigation of the various plans for a canal from the Great Lakes to tidewater; estimates made for several hundreds of gates varying in width from 60′ to 80′, and lifts varying from zero to 50′. Isthmian Canal Commission No. 1 committee on locks decided to make use of these studies as a basis of estimate for isthmian lock gates. Lock masonry designed with a view to the use of the same type of gate as developed by that board. Type of gate the steel mitering gate, with horizontal framing, straight on the downstream side and curved on the other. Rise of sill one-fifth the width of the lock; when the gate is closed the line which joins the centers of the quoin and miter posts makes an angle with the normal to the side wall, the tangent of which is 0.4. Gates sheathed on the upstream side only; where the gates are extremely heavy, they are made partially buoyant by sheathing the downstream face below the level of the lower pool. Upper and lower gates, and an intermediate gate. Intermediate gate forms a lock chamber 400′ clear. Upper and lower guard gates. Formula for the weight of the lock gates. **P-99,** 180.

Special estimates made for gates between the upper and lower locks of the Bohio and Pedro Miguel flights of locks on the Panama route, the head of 84′ at Bohio and 62′ at Pedro Miguel being considerably greater than those for which the formula was developed.

Side walls: Masonry of all the locks rests upon a rock foundation. Figs. 1 to 12 showing sections of the side walls of all the locks of both the Panama and Nicaragua routes. Computation formulas, etc. **P-99,** 181. Table of forces, etc., **P-99,** 182.

Middle walls: Typical cross section shown by Fig. 14. Computation formulas, etc. **P-99,** 183. Diagrams, etc., **P-99,** 180–181.

Lock floors: Floors inverted arches; rock foundations; floors thicker near the gates. Computation formulas, etc. **P-99,** 188.

Miter sills: Stone arches 3′ thick and of varying depth; faced with timber-bearing piece. Drawing shows sills of the lower and intermediate gates to be straight; all others curved.

Approach walls: Quay wall 1,200′ long provided, for tie-up of vessels.

Culverts and valves: Contained inside walls, 2 for each lock, 12′ 6″ high and 6′ 6″ wide. Each culvert connected with the lock by 18 ports 2′ high and 4.5′ broad. Lining of cast iron and brick. Second set of culverts at lower end of Miraflores Lock and Lock No. 8 of the Nicaragua route; made necessary by the difference in density between fresh and salt water. Computation formulas, etc., **P-99,** 189. Culvert valves to be of Stoney sluice type; used very successfully on the Manchester and other canals, **P-99,** 190.

Time of filling and emptying locks: Table giving time for filling and emptying locks, ranging from 10 minutes 39 seconds to 16 minutes 19 seconds for the Panama route, and from 10 minutes 42 seconds to 14 minutes 56 seconds for the Nicaragua route, **P-99,** 190.

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[1] Report, June, 1900. Members of board: Lt. Col. C. W. Raymond, Corps of Engineers, U. S. Army, chairman; Alfred Noble, and George Y. Wisner.

Use of water for lockage of vessels: Outline of possible conditions; computation formulas, etc., **P-09**, 191.

Leakage of locks: Amount dependent on accuracy of fitting; serious leakage might occur at culverts and gates; leakage around quoin posts can be made small; should be no leaking through gates. Computation formulas, etc. **P-09**, 192, 193.

Water for lockage: At Panama, as follows: Lockage, 411 cubic feet; leakage, 225 cubic feet; power, 200 cubic feet; total, 836 cubic feet per second. Nicaragua route: Lockage, 367 cubic feet; leakage, 215 cubic feet; power, 233 cubic feet; total, 815 cubic feet per second. **P-09**, 193.

Costs: Locks, Nicaragua route. Tables showing cost of double locks, exclusive of excavation, but embracing concrete, cut stone, steel, bronze, timber, brickwork, machinery and plant, and approach walls with their concrete and piles. Estimate for single locks, exclusive of excavation. Double locks. Single locks. **P-09**, 194-196.

1906. Lock dimensions: As a basis for all plans, the Board of Consulting Engineers voted 11 to 2 that locks should have minimum usable dimensions of 40 by 100 by 1,000′, **P-06***, 3.

Lockages: Time required to pass a flight of locks at Bohio or at Gatun, on the Panama Canal. By J. W. Welcker. Appendix M. **P-06***, 403–404.

1907-1914. (See Construction and engineering; Projects; Atlantic division; Pacific division; and Locks and dams, above.)

1911. Every known precaution taken to insure safety of locks. Accidents to locks have in nearly every case resulted from misunderstood signals in engine room. To avoid possibility of accident which might render canal useless, authorities should assume charge of all vessels during transit of locks; under such conditions any damage that may result to vessels should be assumed by the U. S., and legislation looking to this end necessary. **P-11**, 62.

Locks, Poe.
Delays in, **P-06***, 421, 423.
Vessel movement in, **P-06***, 7.

Locks, Separate or Scattered.
Effect upon water expenditure, **P-10**, 108.

Lock Structures. (See Structures, Lock.)

Lock, Weitzel. (See Waterways, Artificial.)
Delays in, **P-06***, 421, 423.

Locomotives, P-10, 266; **P-11**, 235, 241; **P-12**, 271.
Blacksmith shop, **P-10**, 266; **P-11**, 235.
Engine room, locomotive department, **P-10** 267.
Gorgona, **P-09**, 144.
Hostling, **P-14**, 260.
Number working, average, central division, **P-11**, 140; **P-13**, 147.
Number working daily, average, central division, **P-10**, 144; **P-12**, 151.
Oxy-acetylene plant, **P-11**, 236.
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Repairs, number of, **P-10**, 271.
Repairs to all equipment except locomotives and cars, **P-10**, 273; **P-11**, 241; **P-12**, 275.

Locomotives, Towing, P-13, 92; **P-14**, 14.
Current duty, Miraflores Lock, **P-14**, pl. 85.
Design for, canals, **P-13**, 9.
Distribution, etc., **P-14**, 109.
Electric, proposed, **P-10**, pl. 85.
Steel girders for tracks, Gatun, **P-12**, 108, pl. 7.

Longevity.
Act relating to prohibition of allowance for, **P-11**, 571, 577, 580.

Lubricants.
Consumption, **P-11**, 211.
Consumption and cost, **P-13**, 248.
Inspection of, **P-13**, 247.

M.

Macadamizing. (See Roads.)
Oiling and macadamizing roads, fifth division, **P-13**, 183.

Macdonald, Donald F. (See No. 223, p. 2366 of this Index.)
Geologist, report, **P-13**, 565–582.

Machinery. (See Dams; Spillways; Locks; Valves; Gates; see Nos. 43, 221, 243, pp. 2362, 2366, 2367, of this Index.)
Erection division, **P-14**, 73.
Erection, locks, **P-12**, 94.
Erection, special force for, lock work, **P-11**, 83.
Foundations, **P-13**, 201; **P-14**, 206.
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Installation, locks, vitrified tile ducts, **P-12**, 87.
List of, by classes and location, **P-10**, 210.
Mechanical appliances, inspection, repair, etc., **P-11**, 204.
Miter, perfect, proposed machinery for forcing, lock gates, **P-10**, pl. 84.
Repairs, total cost of, per service day, **P-13**, 245.
Shops, permanent machine, **P-11**, 205.
Terminal plant, **P-14**, 191.

Machinery and Electrical Equipment.
Inspection department established, **P-11,** 82.

Machinery and Equipment.
Status, Aug., 1905, **P-05,** 141.
Status of bureau work, July 1, 1905, **P-05,** 135.

Machinery, Department of.
Report, **P-07,** 59-102; **P-08,** 74.

Machinery, Motive Power and.
Duties of superintendent, **P-08,** 71.

Machine Shop.
Atlantic division, **P-10,** 132.
Cristobal, **P-07,** 50.
La Boca dredging division, **P-07,** 53.

Machine Shop and Dry Dock.
Colon dredging division, **P-08,** 49.

Magazines, Storage.
Dynamite, Cruces, **P-09,** 220, pl. 91.

Magoon, C. E. (See Nos. 64, 77, p. 2363 of this Index.)
Governor, zone, **P-05,** 28.

Maintenance. (See Costs; Sewers; Waterworks; Panama R. R.; see No. 11, p. 2361 of this Index.)
Act, **P-12,** 599.

Maintenance, Engineer of. (See No. 259, p. 2368 of this Index.)
Report, **P-14,** 67.

Maintenance, Engineer of, Panama R. R.
Chart of organization, **P-14,** pl. 139.

Malaria. (See No. 81, p. 2363 of this Index.)
Cases of, **P-10,** 434; **P-11,** 530; **P-12,** 556; **P-13,** 554.
Preventives, **P-05,** 54.
Statistics, **P-09,** 331.
Malaria; Physical efficiency of working force impaired more by malaria than by yellow fever. May to Aug., 1905, 47 deaths from yellow fever, 108 from malaria. Most common of all diseases on the zone. Due to Anopheles mosquito. More difficult to exterminate than the Stegomyia. Gangs employed with machetes to clear away undergrowth and other breeding places. New arrivals instructed as to cause of malaria, and advised to take 3 grains of quinine a day. **P-05,** 34.

Maltby, F. B. (See No. 202, p. 2365 of this Index.)

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Maps. (See Charts; see No. 137, p. 2364 of this Index.)
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Canal Zone, showing Panama R. R. relocated line, **P-11,** pl. 117.
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Gatun Locks and Dam, breakwater in Colon Harbor, and channel excavation, **P-12,** pl. 78.
Gatun works, Colon Harbor, and channel excavation, **P-11,** pl. 98.
Isthmus with completed canal, **P-12,** 1; **P-13,** 1, frontispiece.
Las Cascadas slide, **P-11,** pl. 108.
Lock canal, 85' summit level, **P-06*,** 7.
Making of, **P-08,** 55; **P-09,** 119.
Map making and lithography division: Maps made of all encampments, and of Isthmian Canal Commission buildings on the Isthmus, of profiles, soundings, benchmarks, old maps, city maps, boundary lines, and some for the Panaman Government. Work in 5 colors done. Some printing and bookbinding done before transfer of latter work to bureau of material and supplies. **P-05,** 116.
Panama R. R. relocated line, **P-09,** 142, pl. 60; **P-10,** pl. 120.
Panama, showing zone and watershed of Chagres, **P-09,** 358, pl. 113.
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Marines.
Appropriation for barracks, etc., **P-13,** 607.

Market.
Culebra, **P-08,** 280, pl. 186.

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Mason, C. F. (See No. 270, p. 2368 of this Index.)

Masonry. (See Costs.)
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Chief, E. C. Tobey, paymaster, U. S. Navy, **P-04**, 38.

Material and Supplies, Division of. (See above.)
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Report, W. G. Tubby, Aug. 1, 1908, **P-07**, 103–107; **P-08**, 221–246.

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Material and Supplies (operations).
1904. Query by Sec. of War Taft as to policy governing purchases of material, supplies, etc., from foreign or American sources, **P-04**, 12.
Department found necessary at once. Isthmian Canal Commission No. 2, Aug. 31, 1904, while at Isthmus, resolved there should be such a division, charged with the receipt, inspection, custody, care, shipment, transfer, issue, and disposition of all supplies, material, equipage, and floating equipment unissued and not in actual use. Governor of zone and chief engineer to have authority to decide on the suitability of supplies, etc. E. C. Tobey, paymaster, U. S. Navy, appointed chief of the department. Proposed later to extend its scope to include a commissary; in view of need for supplying satisfactory food to American employees. Board of inventory appointed to list, etc., the property taken over at transfer; work in progress. List of some of the matter, valued at 98,379,841.60 francs. Transferred material, etc., in better condition than expected. Considerable purchases made at first in open market, but usual U. S. policy of competition to be followed rapidly. **P-04**, 54.
1905. Some of the delay of work of construction due to slowness of getting material asked for months previous, **P-05**, 139.

Regulations governing purchase, delivery, etc.: Purchases; delivery; assistant purchasing agent on the Isthmus; assistant purchasing and forwarding agents in the U. S.; custody and issue of material and supplies; requisitions made on material and supplies division; articles manufactured; scrap material; record of material and supplies; property records; storekeepers; inventories by storekeepers; requisitions for material and supplies to be purchased; inspection; board of surveys; sales. **P-05,** 159–170.

1906. Purchasing offices maintained in various places in the U. S.; circulars, also, distributed through Army offices; total of purchases, year ending June 30, 1906, $8,743,482.05. One general storehouse established near Atlantic terminus, local storehouses supplied therefrom. **P-06,** 11.

1907. Division of material and supplies: Charged with the purchase and proper handling of all material and equipment. Marked diversity of work. All departments rely on this department for their wants. Wants anticipated by frequent purchases in the U. S., based on estimates submitted by divisions, etc. $9,500,000 spent; 90 per cent of purchases being made in U. S. Entailed handling of 37 full cargoes, and 150 partial cargoes. Some items: 23,000,000′ lumber, 254,000 crossties, 4,000 piles, 50,000 tons miscellaneous cargo. Most of the material received at Mount Hope storehouse. Large amount of French plant (boilers, pumps, track, cars, locomotives, cranes, etc.) repaired and placed in service. About 11,000 tons old French material scrapped to U. S. dealers. 4,000 tons used as ballast by Panama R. R. vessels going north. Storehouses located at various points. Fire damaged Mount Hope storehouse to extent of $100,000 Apr. 1, 1907. No delay caused. Building rebuilt in 3 sections. Division charged with care and operation of corrals and equipment used in land transportation on the Isthmus. Corrals located at various points. Over 600 horses and mules, with wagons, etc., in this service. Cost (net) of teams, about $110 per month, one-fourth cost proposed by U. S. contractor. Printing plant, caring for all work on the Isthmus, operated. Organization modified to secure better efficiency. 1,289 employees; expenditures, $755,321.89. **P-07,** 13, 14.

1908. Duties: Charged with the purchase and handling on the Isthmus of all material needed. Charged with the care and maintenance of local transportation and the operation of the Isthmian Canal Commission print shop, and of a typewriter repair shop.
Purchases: Special classes of material and supplies are purchased on requisitions by the purchasing department of the Isthmian Canal Commission in the U. S. The stock of otherm aterial is replenished as the rate of consumption at the various storehouses along the line dictates. Local purchases on the Isthmus consist of material and supplies which are not carried in stock, and which are urgently needed—supplies for engineering parties, for subsistence department, and for hospitals.
Supply: Stock material for general use is distributed from 9 warehouses at important points.
Receipts and distributions: Received to value of $11,607,094.63. Disbursed, $11,685,158.33 of the latter, $182,894.56 covers old French material utilized. Among the items issued the following are notable: 38 steam shovels, 800 cars, 10 unloaders, 10 spreaders, 6 ballast plows, 9 cranes, 8 dredges, 5 tugboats, 12 steel barges, 2 air-compressor plants, 172 rock drills, 13 rock channelers, 508,000 pounds track bolts, 1,684,000 pounds track spikes, 119,150 pounds angle bars, 470,000 tie plates, 481 15′ split switches, 628 frogs, 15 oil fuel tanks, 2 launches, 4 concrete mixers, 1 road roller, 3 motor cars, 1 material-handling plant, 1 15-ton rock crusher, 4 saddle-tank locomotives, 19,254½ tons steel rails, 501,876 ties, 3 electric cranes, 18 hoisting engines, 38,985,521′ lumber, 34,657 piles, 501,574 switch and crossties, 246,000 brick, 8,852,000 pounds dynamite, and 54,000 pounds blasting powder.
New buildings: Rebuilding of large general storehouse at Mount Hope completed; restocked. New storehouses built at various places. Four storage magazines for dynamite, etc.
Transportation: Handled at 16 corrals, for 632 animals. Isthmian Canal Commission owns 397 vehicles (wagons, carriages, ambulances, scrapers). **P-08,** 23.
Printing shop: Supplies all the stationery and printing; 14 presses in plant. Cost of printing, $38,513.10. Stationery and engineering supplies cost $32,758.
Employees: 1,220. Pay roll, $665,126.07. **P-08,** 22, 23.

Meals. (See Hotels; Labor; Kitchens; Messes; Subsistence.)
Cost of, at hotels, **P-09,** 229.

Mears, Lt. F. (See No. 234, p. 2367 of this Index.)

Mechanical Analysis, Materials.
Gatun Dam studies, **P-08,** 144.

Mechanical Committee.
Shops, **P-11,** 231.

Mechanical Division. (See Nos. 133, 251, 265, pp. 2364, 2368 of this Index.)
1905. Repair of locomotives and rolling equipment, erection of cars, steam shovels and heavy and light repairs to almost every class of machine in the zone. Over 170,000 pounds of castings made. Some shop construction done. Nearly 300 machines installed in shops. Large list of equipment under order. Old, obsolete machinery

cleared away. All new machinery expected to be soon in operative condition. P-05, 113.

1906. Operations of this division begun with shop organizations at Cristobal, Bas Matachin, Empire, and Culebra. On June 30, 1906, organization consisted of 1,812 men. Principal work the repairing and enlarging of shops, building of new ones, repairing and maintaining locomotives, dump cars, and miscellaneous equipment of the old French stock until it could be replaced with more modern and American plant. Division handicapped by unsatisfactory employees. Air-compressor and pipe-line plants erected at Rio Grande, Empire, and Las Cascadas; plans made for capacity of 30,000 cubic feet per minute for air compressors throughout the cut. Installation of electric plants. Table showing nature of miscellaneous work done. "Division * * * has had to create its own plant, to repair old, practically worn-out, and dismantled equipment * * *; it has had to keep up repairs on all machinery and equipment, and it has also had to design, make specifications, receive and erect, ready for service, new and modern equipment." P-06, 107.

1907-08. (See Municipal Engineering; Motive Power and Machinery.)

1909. Mechanical division (second division, O. C. E.).—Organization: Placed under the supervision of the second division of O. C. E. At the beginning of the year shops at Gorgona, Empire, and Paraiso in charge of a master mechanic having jurisdiction over the field repair shops. There was also an electrical subdivision under an electrical engineer.

Concentration of work: During the year shops at Paraiso closed; heavy work there transferred to Gorgona and Empire. Running repairs to cars and locomotives transferred to Pedro Miguel engine house. Work of electrical subdivision consolidated with the work of the Gorgona shops; both placed in charge of the electrical engineer. All heavy repairs to equipment other than steam shovels and steel cars, as well as manufacturing work, performed at Gorgona shops. Heavy repairs to steam shovels and steel dump cars made at Empire.

Gorgona shops: Extensions made to machine shop, boiler shop, and planing mill. Car shop made for car repairs. Lye vat built for cleaning engine parts. Oil fuel adopted; great saving. 4,586,342 pounds iron castings made, and 333,416 pounds brass castings. Extensive repairs made to Lidgerwood flat cars, as hard usage necessitated practically rebuilding larger portion of those on hand.

Electrical subdivision: Controls all electric lighting on the Isthmus, except in Cristobal and Colon; latter operated by Panama R. R. Panama R. R. power plant at Balboa transferred to the Isthmian Canal Commission July, 1908. Plant augmented; electric current extended to various places.

Empire shops: Various extensions made. Machinery of Paraiso shop, when closed, transferred, most of it to this place. P-09, 19, 20.

1910. Second division, O. C. E., has charge of all mechanical questions and supervises expenditures, preparation of estimates, allotments for work, and cost keeping. Under H. H. Rousseau, U. S. Navy.

To reduce delays on account of breakdown of machinery, etc., which reflect largely in unit cost of work, and to provide proper facilities for overhauling plant and equipment, as well as manufacturing necessary repair parts, large shops provided at certain points on Isthmus, in which are employed 1,399 "gold" men and 2,992 "silver" men. Other small shops employing one-half dozen or less men distributed around. Cars converted into portable machine shops are also used, and in a similar way floating machine shops provided for repairing marine equipment.

Repair shops and equipment on Isthmus adequate to meet requirements during construction. Nothing as yet done toward permanent shop facilities needed after completion of canal; but Isthmian Canal Commission declared itself in favor of policy of confining permanent shop facilities to two points.

Special attention paid to reducing cost of maintenance and operation of equipment in shops, including the standardization of salaries and wages, and of material and supplies. Two traveling engineers appointed, who have been instructing and supervising engineers, firemen, and hostlers, in use of fuel and oil in connection therewith. Saving resulted of fully 50 per cent in amount of lubricants used, and of approximately 10 per cent in coal consumption per train-mile.

On Apr. 29, 1910, position of inspector of shops established, and toward latter part of year traveling engineer appointed to inspect fuel and oil consumption on Isthmus, except on locomotives and marine equipment.

Gorgona shops: Empire shops transferred to central division for performance of steam shovel, general repairs, and manufacture of steam shovel repair parts. Repairs to steel cars, formerly done at these shops, transferred to Gorgona shops, centralizing at latter shops all repair work to rolling equipment other than steam shovels, as well as all manufacturing work. Car-repair yards at Las Cascadas and Gamboa abolished. Work at Pedro Miguel yard confined to lightest running repairs only. Under new car-inspection service, every car in service given thorough inspection once a day.

To provide for increased work at Gorgona shops, additions to buildings and equipment made. Among the former a new 2-story building 42′ by 100′ for storage of patterns aggregating

16,000; estimated value, $150,000 to $200,000. Old pattern-storage building converted into brass foundry and 3 crucible melting furnaces installed. This enabled enlargement of iron foundry by addition of 4,160 sq. f.; 4,820,762 pounds iron castings and 393,995 pounds brass castings made.

Division continued operation of all electric-power plants, except those at Gatun and Miraflores, furnishing current for about 31,000 lights. Pole line 5½ miles long constructed between Gatun and Cristobal to convey current from Gatun plant to Panama R. R. old plant at Cristobal.

Air compressors also under this division, and 7,227,203,513 cubic feet of compressed air generated. Additional compressors installed at Empire and Rio Grande plants, and 18,810′ of main pipe line removed and rebuilt on account of slides occurring through Culebra Cut, and 3,600′ of 8″ main installed between Balboa plant and Ancon crushing plant of Pacific division.

Appropriations: Available to close of fiscal year 1909, $210,146,468.58, or 56 per cent of total estimated cost, fixed at $375,201,000. June 25, 1910, $37,855,000 appropriated for fiscal year 1910–11, leaving $127,199,531.42 of estimated cost of canal to be appropriated. Total classified expenditures for canal work to June 30, 1910, $191,258,113.93, of which $31,188,426.37 were net expenditures during fiscal year. Of total classified expenditures to June 30, 1910, $25,699,450.81 for plant and equipment for construction work, of which $4,388,511.55 expended during fiscal year. **P-10**, 32–34.

1911. The employees in all shops on Isthmus totaled 4,405, of which 1,532 "gold" employees and 2,873 "silver" men. Hourly "gold" men taken on during year, 94 per cent of force employed, indicating that average length of service on the Isthmus for mechanical trades continued to be about one year.

New shop erected and put in operation, Toro Point, for repairing locomotives, cars, and other equipment used in construction of breakwater. Equipped with machines taken from other shops. Shed at Pedro Miguel shop used for repairing cars doubled in size to save time previously lost by workmen during rains. At Gorgona shops addition to erecting shop made for pipe, tin, and copper shop, so as to move equipment therefor from boiler shop, the latter needing additional space. Small building erected for oxy-acetylene plant, and small building erected and provided with 25-ton crane, affording facilities for making large iron castings. Order placed for steel casting plant consisting principally of a 2-ton converter, blower, and sand grinder; when installed, stock of steel castings kept on hand can be reduced and practice stopped of making repair parts urgently required of cast iron and brass. Permanent equipment augmented by addition of one 6″ turret lathe for making bushings, two heavy milling machines for cutting gears and general work, one automatic tool grinder, oxy-acetylene plant, one washer cutter for making washers out of scrap metal, 25-ton overhead crane for use in foundry, and Taylor-Barth belt outfit.

Work in Cocoli shop transferred to mechanical division Sept. 1 and shop closed Sept. 15. Lirio planing mill closed and manufacture of woodwork consolidated at Gorgona. Keeping of permanent gang of craftsmen and helpers for making repairs to cableways and concrete mixers at Gatun Locks and day repairs to steam shovels done away with. Consolidation of heavy repairs at Gorgona and transfer of repairs to vessels and other apparatus in vicinity of Colon and Cristobal to dry-dock shops enabled closing of blacksmith, machine, boiler, and erecting shops of Panama R. R. in Cristobal. So that repair and manufacturing work could be done with greater dispatch, night shifts put in machine, erecting, and boiler shops in Gorgona, Aug. and Sept. While work of the class involved usually more expensive at night than during day, night shifts have proven efficient and save expense by elimination of overtime. Another advantag was in reducinge length of time required for completing urgent orders. By putting on night shift in wood-car repair shop Feb. 1, Lidgerwood flats cut out of service for light and medium repairs on one day returned to service next morning.

According to program, Gorgona shops to be retained in operation until waters of Gatun Lake reach elevation 70. By that time, manufacturing and repair work, especially in connection with locomotives, cars, and excavating machinery, will have largely diminished and steps can be taken for erection of necessary buildings to which transfer of machines now at Gorgona can be made. Shops at Balboa and Cristobal in operation, together with Panama R. R. machine shops, to afford necessary repair facilities while transfer of machinery from Gorgona in progress.

At beginning of year additional traveling engineer appointed to have supervision over fuel and oil consumption and to supplement work of two traveling engineers, whose jurisdiction extended to locomotives only, and later to supervising and instructing engineers in respect to handling oil, and firemen in regard to methods of firing and fuel consumption. Duties of new traveling engineer covered steam shovels, unloaders, spreaders, and all stationary plants, and subsequently extended to marine equipment. Satisfactory results in saving both fuel and lubricants.

Current for lighting and power generated at 5 stations—Balboa, Miraflores, Empire, Gorgona, and Gatun. Output of Gatun and Miraflores plants largely used in construction work in Atlantic and Pacific divisions. Cost per kilowatt hour averaged $0.026. Oil fuel used in all stations. Current generated at Gatun and Miraflores plants by steam turbines, at Empire and Gorgona plants by noncondensing engines, and at Balboa plant by condensing engines.

Principal air-compressor plants located at Las Cascadas, Empire, Rio Grande, and Balboa, and furnish compressed air to central and Pacific divisions, and along high line around Gold Hill on relocation of Panama R. R. Output aggregated 8,261,199,541 cubic feet. Air for Gorgona shops furnished by smaller plant.

Total appropriations by Congress available to June 30, 1911, $248,001,468.58, or 66 per cent of total estimate of $375,201,000 for canal. By act Mar. 4, 1911, additional appropriations made for fiscal year 1912, $45,560,000, exclusive of fortifications, leaving $81,639,531.42 of total estimate of canal to be appropriated. By June 30, 1911, $225,470,053.26 charged into work. Of this, $33,048,607.97 expended during fiscal year 1911. Of total classified expenditures to June 30, 1911, $27,580,724.37 for plant and equipment for construction, of which amount $626,330.86 expended during fiscal year 1911. **P-11,** 33–36.

1912. Second division, O. C. E.: This division has charge of all mechanical questions that may arise and supervises expenditures and allotments for the work. The third division of O. C. E. abolished Jan. 24, 1912, after resignation of C. M. Saville, assistant engineer formerly in charge, and work transferred to second division. To this division also assigned design of dry dock, coaling stations, shops, and appliances in form of harbor tugs, cranes, and barges. Division in charge of H. H. Rousseau, U. S. Navy, as assistant to chief engineer.

On the assumption that favorable legislation would be provided, general and detailed plans of terminals undertaken with view to beginning work of construction as soon as funds become available. General layout of terminals at Atlantic and Pacific entrances arranged with object of affording sufficient wharves and piers to meet all requirements when canal is opened, and to permit extension. In addition to wharf space, the general plan provides necessary facilities for docking and repairing all classes of vessels and for furnishing them with fuel, fresh water, and supplies of all kinds. As these facilities may be required for military purposes as well as commercial, all general plans submitted to Navy Department for its views, which have been followed in final designs.

Main coaling plant at Atlantic end of canal will be located on north end of island opposite Dock No. 11, at Cristobal, with railroad connection across French canal. It will be capable of handling and storing 200,000 tons of coal, with possible increase of 50 per cent; 100,000 tons will be in subaqueous storage. Coaling plant at Pacific terminus will be located at Balboa, adjacent to site of dry dock, and will be capable of handling and storing 100,000 tons of coal, with possible increase of 50 per cent; subaqueous storage will be provided for 50,000 tons. Arrangements are made for supplying fuel oil, and 4 tanks of 40,000 barrels capacity each under advertisement, to give initial storage capacity of 80,000 barrels at each terminus.

Piers or docks on Atlantic side to be protected against storms by mole or breakwater extending out in prolongation of line separating zone from Colon; to be 1,000′ in length, 200′ in width, and 300′ apart. At present the Panama R. R. Co. engaged in building one of the piers, with slip on either side, and a 1,000′ wharf, together with necessary length of mole or breakwater to afford protection. On Pacific side piers for commercial use will be placed at right angles to axis of canal, with ends of piers 2,650′ from center of 500′ canal channel. Piers will be 1,000′ long and 200′ wide, with 300′ slips between piers. One pier is to be undertaken. Superstructure of commercial piers and wharves will be one-story steel sheds, with clear height of 25′. Sheds, of fireproof construction, will cover entire pier, except for space of about 18′ along each side and outer ends. Track will extend along each edge of piers at floor level, and two tracks will run through center of pier sheds, depressed to bring car floor level with floors of sheds.

Plans provide for one dry dock capable of accommodating vessels passing through locks; usable length, 1,000′; entrance width, 110′; depth over keel blocks, 35′ at mean sea level. Dock will be built in the rock, which will be lined with concrete. Borings indicate that rock is strong, solid, and well suited for such construction. In lieu of marine railway at first contemplated for smaller vessels, auxiliary dry dock will be provided, and suitable foundation on similar rock found for it. This dock will have usable length of 350′, entrance width of 71′, and depth over keel blocks of 13½′ at mean tide. On Atlantic side "present" dry dock at Cristobal, which has usable length of 300′ and width at entrance of 50′, with depth over sill of 13′ at mean sea level, will be retained.

Plans for various shops, foundries, storehouses, and subsidiary buildings approved, and specifications prepared for furnishing material, as it is desirable to have erection completed and machine shops moved from Gorgona by July 1, 1913. Machines now in use will be installed in new shops, and they will be electrically driven, individual and group drives being used. Floor area of buildings in connection with shops aggregates 491,380 sq. f. Until further requirements more definitely developed, shop facilities for emergency repairs will be retained in vicinity of dry dock at Cristobal.

For expeditious and convenient handling of lock gate leaves, as well as for commercial and other canal needs and for general wrecking purposes, necessary to provide floating crane of largest practicable capacity at each terminus. An investigation under way to determine best manner in which these requirements can be filled.

For handling vessels of largest size, harbor tugs of high power required and must be secured, as tugs now owned by Isthmian Canal Commission will not be satisfactory or economical for that service. Intended to provide two large harbor tugs at each end.

Expected that large quantity of coal will have to be furnished to shipping in barges or lighters; canal must be equipped with sufficient number, not only for this service, but also for supplying fuel oil and fresh water. Navy Department recommended provisions be made for sufficient lighters to give capacity of 16,000 tons of coal for Atlantic terminus and 8,000 tons for Pacific end.

Locations of permanent administration building and canal headquarters and permanent settlements for employees determined. Permanent administration building will be on knoll west of Ancon quarry, and quarters for employees attached thereto will be erected in general area adjacent to and northeast of this building. Employees connected with shops, docks, and other terminal facilities will be housed in quarters erected in area surrounding slope of Sosa Hill and on fill adjoining Ancon-Balboa highway. There will be permanent settlement at Pedro Miguel for employees of Pacific Locks and one at Gatun for employees of Atlantic Locks. Settlement at Cristobal will be maintained and also one at Ancon.

During year applications received from individuals and companies for leases of land in vicinity of Atlantic and Pacific terminals for various purposes connected with operation of the canal.

Three first-class meteorological stations at Ancon, Culebra, and Cristobal continued. Two second-class stations at Gatun and Pedro Miguel, at which wind velocity, temperature, and rainfall recorded. Twenty-six rainfall stations in operation, 15 of which equipped with standard and 11 with automatic rain gauges. Evaporation stations in operation at Ancon, Rio Grande Reservoir, Gatun Lake, Brazos Brook Reservoir, and Colon. Two seismograph stations in operation, one at Ancon and the other on Guarapo Island, near Gatun. Duplicate automatic tide registers located on Dock No. 1 at Colon and two on the Panama R. R. dock at Balboa. Gauging stations maintained throughout the year, one on Chagres River at Gatun, one at Gamboa, and one at Alhajuela. Automatic water-stage registers put in operation above and below spillway at Gatun and on Chagres River at Bohio, Gamboa, Alhajuela, and Vigia. Automatic registers on Trinidad and Pedro Miguel Rivers continued in operation throughout the year at the old locations.

July 1, 1911, to July 1, 1912, minimum dry season and total flow for 12 consecutive months for years of record occurred. Previous minimum dry-season flow occurred during calendar year 1908. Total flow for 1911 was minimum flow for calendar years of record since 1905, and new low-water records established at Alhajuela and Gamboa. At Alhajuela minimum 91′ on Apr. 20, 1912, and at Gamboa 43.5′ on May 7 and 8, 1912. Previous low-water records, 91.86 at Alhajuela on Apr. 26, 1905, and 44.40 at Gamboa on Apr. 4, 1911. According to discharge measurements at Gamboa, heaviest freshet of year occurred Aug. 21, 1911, when there was a rise at that point of 11.4′ and discharge 35,120 cubic feet per second. Minimum flow at Gamboa on Apr. 10 and 11, 1912, discharge 250 cubic feet per second. Backwater from Lake Gatun interfered with gauging work on Trinidad River, at Bohio, and on Gatun River.

Temperature for 1911 generally above normal. July was warmest month in Ancon and Culebra and Dec. at Colon. Highest temperature recorded, 95° F., at Ancon, Oct. 16, and lowest 65° F., at Culebra, Mar. 27.

Rainfall in zone below normal, being lightest of record at Gamboa, Bohio, and several of stations for which only few years' records available. Deficiencies ranged from 10 per cent at Balboa to 41 per cent at Bohio. Dry-season rainfall 12 per cent of annual total in Pacific section and 8 per cent and 9 per cent, respectively, in central and Atlantic sections. Average rainfall for 1911, 67.20″ in Pacific section, 79.10″ in central section, and 116.45″ in Atlantic section. Rainy days in Pacific section 172, in central section 214, and in Atlantic section 265. Heaviest precipitation occurred at Porto Bello, Nov. 29, when during the storm 7.60″ of rain fell in 12 hours, maximum fall for 5 minutes being approximately 2.48″.

There was moderate excess of wind movement at the various stations during 1911. Prevailing direction from northwest at Ancon and Culebra and from north at Colon. Relative humidity generally below normal during 1911 and first half of 1912; mean for 1911, 81 per cent at Ancon and 84 per cent at Culebra and Colon.

Slight seismic disturbances of frequent occurrence. Stadia survey made to locate ridge line between upper Gatun River and Atlantic Ocean, and 19 miles of line run between Mount Bruja and Santa Rita Mountain.

Stadia survey made of Atlantic coast line in vicinity of Margarita Island, near Colon, and triangulation station established on island. Majagual and Escondido Rivers run up to limits of tidewater. Several islands and inlets not heretofore shown on maps located.

No marked changes in conduct of mechanical work. Constant efforts made to reduce cost of repairs to equipment. General repairs were required to greater extent.

Principal shops at Gorgona, and policy of concentrating manufacturing work and repairs to rolling equipment at these shops continued. With construction work drawing to a close, general policy of gradually reducing repair parts and other material carried in storehouses caused mechanical division to handle more and more manufacturing work on short notice, and also resulted in installation of Tropenas 2-ton converter, blower, sand grinder, and all necessary apparatus for manufacture of steel castings. Two additional pipe cutting and threading machines—one 8″ and one 12″—installed in main shops, and in planing mill French horizontal compound engine replaced by stationary engine removed from Lirio planing mill and supplemented with 50-horsepower motor.

Engine houses and repair shops operated at Pedro Miguel, Gatun, Las Cascadas, Gamboa, and Gold Hill. Removal of material from top of slides on Gold Hill side of cut required establishment of engine house, and temporary repair shop and storehouse, made of two old box cars, were installed, with necessary storage and cleaning tracks. Gatun machine and repair shop transferred to mechanical division, and July 1, 1912, Empire shops for repair of steam shovels also transferred to same division.

Operation and maintenance of air-compressor plants at Las Cascadas, Empire, Rio Grande, and Balboa under mechanical division, as well as operation and maintenance of electric power and lighting plants at Cristobal, Gorgona, Empire, and Balboa. Output of air-compressor plants operated during the year, 8,795,157,453 cubic feet of free air at 70° F. Increased construction work on Pacific division and decrease of work on north end of Atlantic division increased air consumption at Pedro Miguel and Miraflores so as to necessitate removal from Las Cascadas plant and installation in Aguadulce pumping plant of Pacific division of two 2,200′ Ingersoll-Rand compressors. Mechanical division's electric plants totaled output of 4,966,953 kilowatt hours, which, with 2,279,151 kilowatt hours furnished by construction divisions to mechanical division, makes total of 7,246,104 kilowatt hours.

Total appropriations by Congress to June 30, 1912, $293,561,468.58. Act Aug. 24, 1912, additional appropriations made for fiscal year 1913 amounting to $28,980,000, exclusive of fortifications. June 30, 1912, $259,653,236.74, or about 69 per cent of the total estimate, had been charged into the work. Of this amount, $34,183,183.48 expended during fiscal year 1911, or about 9 per cent of total estimate of canal. Of total classified expenditures to June 30, 1912, $32,547,720.75, or about 12½ per cent, for plant and equipment for construction and for 4 steamships; of this amount, $1,254,697.70 expended during fiscal year 1912. P-12, 39–45.

1913. Act Aug. 28, 1902, authorizing construction of canal directed President to "also construct such safe and commodious harbors at the termini of said canal as shall be necessary for the safe and convenient use thereof." Estimate of cost of canal, in Dec., 1908, made provision for construction of necessary breakwaters, but did not include anything for such harbor improvements as may be classed as terminal facilities, which had been operated and provided heretofore by the Panama R. R. Co. in connection with handling of its commercial and other business. Early in the work it was apparent that terminal facilities required by the Panama R. R. would not be adequate for probable needs of shipping, and, in view of the fact that savings on estimates would probably enable their construction as part of canal work, this advocated in 1910. Act Aug. 24, 1912, authorized President to "establish, maintain, and operate, through the Panama R. R. or otherwise, dry docks, repair shops, yards, docks, wharves, warehouses, storehouses, and other necessary facilities for the purpose of providing coal and other materials, labor, repairs, and supplies for vessels for the Government of the U. S. and, incidentally, for supplying such at a reasonable price to passing vessels." Act Aug. 24, 1912, made necessary appropriations. While, in anticipation of favorable action by Congress, some preliminary work undertaken, active operations could not be begun until last fall; consequently terminal facilities can not be completed by time canal ready for passing vessels.

Pacific terminals, being constructed by Isthmian Canal Commission, will consist of main dry dock capable of docking any vessel that can utilize the locks, a smaller dry dock for use of smaller craft, plant for supplying coal and fuel oil to vessels, necessary wharves and piers for commercial purposes, and permanent shops for use in connection with dry docks.

Atlantic terminals consist of wharves and piers at Cristobal, including Cristobal mole, all being constructed by Panama R. R. at its own expense, and main plant for supplying coal and fuel oil to vessels; cost of coaling plant will be divided between Isthmian Canal Commission and Panama R. R. Co., while Isthmian Canal Commission will furnish facilities for oil. General drawings showing layout of these terminals will be found in report for 1912.

General design of dry docks worked out and preparation of detail drawings commenced. Mitering lock gates will form closure to dock, and beyond gates proper a seat for floating caisson which will be constructed for general canal use. Dock will be flooded by longitudinal ducts in side walls communicating with dock body through grated openings in floor along bottom of walls. Water will be controlled by 4 metal "wagon-body" valves operated by suitable machinery. Time required for flooding at extreme high water estimated at 25 minutes. Pumping plant for emptying dock, 4 vertical shaft centrifugal pumps driven by electric motors. Discharge from pumps will be carried through concrete duct entirely separate from flooding ducts. Time required for pumping out estimated at 2 hours and 20 minutes at mean high water. Suitable tracks for a 50-ton locomotive jib crane will be provided around dock. Capstans and bollards will be installed and a pipe tunnel, with suitable outlets, will be constructed around dock. Stairways leading to floor will be built. Contract entered into Oct. 22, 1912, for one pair of steel mitering leaves and fixed irons to be fabricated and delivered on Isthmus.

Smaller dry dock will be closed by a floating steel caisson bearing against granite sills when in place. Flooding will be similar to that for larger dock and flow of water will be similarly controlled. For emptying dock pumping plant of larger dock will be utilized. Access to floor of dock will be by means of 4 stairways.

Wharves and docks contemplated will consist of quay wall 1,238′ long between head of Slip No. 1 and northeast end of Panama R. R. concrete dock, and 1 pier 1,000′ long by 201′ wide. Permanent walls will be built at ends of slips, each 303′ wide, so constructed that part of length of each will afford landing places for small boats. Including length of wharf constructed for Panama R. R. Co. and completed during previous year, total water frontage under construction will be 4,650′ long. Quay walls and all of Pier No. 1, excepting center section 50′ wide, will be supported on circular reinforced concrete piers sunk to rock; 50′ center section of Pier No. 1 will be rock fill. Slips will be excavated to 45′ below mean tide. Elevation of Pier No. 1 and the adjoining wharves at head of slips placed at 16′ 6″. Level of quay wall adjoining Panama R. R. dock fixed at elevation 17, same level as Panama R. R. dock.

Coaling station on Pacific side will be adjacent to site of dry dock and will be capable of handling and storing 100,000 tons of coal, with possible increase of 50 per cent. Subaqueous storage will be provided for 50,000 tons. Specifications issued for coal-handling plants at the two terminals. Bids opened June 14, and when award is determined plans conforming with machinery will be prepared for substructure. Specified rate for unloading coal from vessels into storage piles fixed at 250 tons per hour for each machine; desire is to unload 2 vessels at one time at Atlantic plant, with 2 unloading machines to each vessel, and 1 vessel at Pacific plant with 2 machines. Reloading capacity—that is, transferring coal from storage into collier or barge—fixed, after consideration of reloading capacity of modern commercial plants in U. S., at rate of 500 tons per hour for each machine. Proposed to equip Atlantic plant so that 2 vessels can be loaded at one time, with 2 machines serving each vessel, and on Pacific side so that 1 vessel can be loaded with 2 machines.

Main machine shops located at Gorgona, which will be flooded by lake as waters rise. Shops at Balboa and Cristobal generally adequate for maintenance and repair of dredging fleet. With adoption of policy of giving repair facilities to any vessel that could use the locks, as well as to Navy, construction of new shops near dry docks became necessary. Permanent shops will consist of 18 buildings for machine, erecting, and tool shops; forge shop; steel storage shed; boiler and shipfitter shop; general storehouse; paint shop; car shop; planing mill; galvanizing plant; lumber and equipment shed; pattern storage; foundry; coke shed; boiler house; roundhouse; gas house; paint house; and sand house. In addition to office building, 9 auxiliary buildings.

On Pacific terminals preparatory work begun; operations pushed. Site cleared by removal of settlement at Balboa, as well as buildings which formed old town. Panama R. R. yard abandoned after new yard and track facilities provided for temporary use. Considerable difficulty experienced in carrying on work expeditiously and economically because of interests of other divisions and departments whose work and operations could not be interrupted. To provide room around head of location of main dry dock for tracks and highway leading to old French pier, northwest slope of Sosa Hill removed, 184,682 c. y. rock and 181,729 c. y. earth, or total of 366,411 c. y. excavated. Total quantity excavated in preparing site, 389,567 c. y. Greater part of material used to fill in adjacent swamp to bring area up to adopted grade, and some rock furnished Atlantic division for paving south slope Gatun Dam. Original surface elevation of dry-dock site was 18; deepest general excavation for foundation will therefore be about 74′. Lowest shovel cut June 30, 12′ below sea level, on coaling-plant site at southwest end of excavation. From this site 203,699 c. y. removed, of which 56,900 c. y. rock. Site for smaller dry dock at present occupied by shipways and shops of dredging division. To protect entrance of main dry dock and entire area to be occupied by smaller dock, and to enable removal in dry of as much rock as possible from entrance basin of main dry dock, as well as to facilitate construction of coaling-plant quay wall and basin, cofferdam around these various works begun Apr. 1, 1913. It will be about 1,000′ in length.

For construction of quay walls and pier rock found at an average elevation of 60′ below mean tide, in some cases being as high as

33′ and in others as low as 66′ below this level. Elevation of original swamp was about 9 and material through which concrete cylinders to be sunk is fine, sticky, black clay with thin strata of sand. Cylinders are sunk by open-caisson method. They consist of sections of reinforced concrete shell in 6′ lengths, 1′ thick, and 7½′ outside diameter. About 4,750 sections required and special plant for their manufacture built. Steel collapsible forms used. Bottom section of each cylinder 8′ outside diameter and 6″ thick, with cutting shoe on the bottom. Excavation done by hand and by orange-peel buckets. When cylinders would not sink of their own weight, descent facilitated by use of cast iron and concrete weights in conjunction with water jet. Not considered advisable at this late date to increase plant, so progress of sinking cylinders depended on crane service available. After cylinders were sunk several feet into rock they were filled with concrete. They are to be capped by reinforced concrete beams for supporting floor. Area within which quay walls and pier to be constructed inclosed by dike begun July, 1912. Of 28,500′ of cylinders required, 12,435′ placed. Of this, 8,450′ were for main quay wall, 289′ for walls at head of Slips 1 and 2, and 3,696′ for Pier No. 1.

Greater portion of area to be occupied by shops brought up to grade by filling low, swampy land. Natural surface of ground not sufficiently stable to hold up buildings; necessary to reach rock for foundations by excavating to it where sufficiently near the surface, or by driving piles to rock, in places as low as 56′ below sea level. Near water front necessary to use 4′ steel cylinders, filled with concrete and sunk to rock, as foundations. Piles driven, 3,750, and 7,787 c. y. concrete placed in footings and in tunnel.

Operating tunnel, running through center and at right angles to length of main shop buildings, under construction for carrying and making accessible all pipe and cable conduits. Main trunk will have clear height of 6′ and width of 4′ 6″, with branches of same height and width of 3′ 6″. Tunnel will contain all power, light, telephone, and fire-alarm cables, and water, steam, fuel oil, and compressed air mains, and main sewer. Rain water will be carried off the area occupied by shop buildings by means of surface gutters and drains. For its construction steam shovel mounted on skids, with special boom, commenced work Mar. 20, 1913. Where hard rock is not deeper than about mean sea level tunnel built on piers excavated to rock; at all other points carried on wooden piles driven to rock and cut off below mean elevation of ground water. Built in sections 15′ in length, special means being provided to make tunnel as water-tight as practicable.

Work started June 5, 1913, on foundations for machines for planing mill; considerable portion of concrete necessary for these and for floor of building completed during year. 25 miles of track laid, of which amount 9,212′ permanent tracks for Panama R. R., remainder for construction purposes. Road at foot of Sosa Hill reconstructed, 3,300′ long.

Steel framework for shop buildings, about 6,000 tons, being furnished and erected under contract dated Oct. 22, 1912.

Contract made Oct. 24, 1912, for 6,500 squares of reinforced cement tile roofing for all quarter-pitched roofs of the machine shops. All tile being manufactured on Isthmus, at Paraiso. Contract required all plant to be on Isthmus by Jan. 25, 1913, and completion of manufacture by June 25, 1913.

For Atlantic terminals quay wall and one pier practically completed by Panama R. R. during year, the material purchased for steelwork for sheds, and subsequent contract made for erection. Panama R. R. also made diamond-drill borings at site of coaling station, and work begun by dredging division June, 1913, drilling and blasting preparatory to dredging alongside proposed coaling pier. In designing permanent shops principal aimed at to reduce to minimum cost of repairs and renewals, without exceeding reasonable first cost.

Selection and location of equipment in different shops practically completed. Greater number of machines and tools for permanent shops will be taken from "present" shops. Electric power at 44,000 volts is to be delivered by transmission line to substation adjacent to pump well of Dry Dock No. 1, where voltage will be reduced to 2,200 volts. Shops have been arranged in 4 groups as regards electric distribution and each group provided with transformers and switchboards for reducing voltage. Power used in plant will be 3-phase, 25-cycle, 220-volt; except 220-volt direct current in machine shop for variable-speed tools. Duplicate motor-generator sets will be installed.

Investigations and inspections made of the principal floating cranes in U. S. and Canada, as well as abroad, with view to determining type of crane to best meet canal requirements; conclusion that 2 floating cranes of largest size would be necessary. Oct. 30, 1912, proposals invited for delivery of 2 floating cranes of revolving type, having maximum lifting capacity of 250 gross tons. Award made Apr. 17, 1913, to the Deutsche Maschinen Fabrik, A. G., for approximately $827,550 for the 2 cranes, delivered in 550 days.

Investigation and inspection of most modern and largest harbor tugs in use on Atlantic coast of U. S. and in leading ports of England also made during last 2 years, and estimates for year 1913–14 included amount considered sufficient for purchase of 4 such tugs. Arrangements made at close of past year for preparation of plans and specifications for suitable tugs.

Numerous applications received from coal dealers for loading space for handling of coal in supplying vessels. No authority exists for leasing any land or land under water in zone, except act of Feb. 27, 1909, which provides for leasing of land for agricultural purposes only. Never intended that U. S. should exercise monopoly of coal business on Isthmus, but to utilize coal stored here for use of Navy in maintaining uniform prices of this product to shipping. To encourage individuals and companies in business of furnishing coal to vessels which use the canal, policy adopted of providing storage in connection with both coaling plants for coal piles of individuals and companies who desire to participate. There will be certain rental and a real estate tax of 1 per cent of value of improvements, should any be made, and a merchandise tax of 5 cents for each 2,000 pounds of coal sold. U. S. will do all handling; charge for putting coal into storage and taking it out; for use of coal barges and other labor in connection with this service will be fixed at cost price to the U. S. for such service. Same policy adopted with reference to oil. Proposed to equip wharf in vicinity of coaling station at Pacific terminus and Docks 13 and 14 at Mount Hope on Atlantic side with fuel-oil supply and delivery mains in duplicate, together with necessary pumps, so that the U. S. will be able to handle satisfactorily all fuel oil, including fuel oil of individuals and companies who may wish to participate in fuel-oil business on Isthmus, on same general terms as those applying to coal business. Contract was entered into Oct. 1, 1912, for 4 storage tanks 93′ in diameter and 35′ in height, each having a capacity of 40,000 barrels, to be erected at cost of $62,800. At end of year tanks had been practically completed, 2 at Mount Hope and 2 at Balboa dump, southeast of Sosa Hill, and plans under way to connect them with water front.

Three first-class meteorological stations at Ancon, Culebra, and Colon continued. Wind records kept at Gatun, Pedro Miguel, Sosa, and Miraflores. 26 rainfall stations in operation, 15 of which equipped with standard and 11 with automatic rain gauges. Evaporation stations maintained at Ancon, Rio Grande, Gatun Lake, Brazos Brook Reservoir, and Colon. Seismograph stations in operation at Ancon and Gatun. Duplicate automatic tide registers located at Colon and Balboa. For use by Fortification Board, maximum and minimum temperatures recorded on Miraflores dumps. Regular gauging work discontinued on smaller streams at end of 1912, work being interfered with by backwater from Gatun Lake.

Most important hydrological change was rise of Gatun Lake. On July 1, 1912, elevation was 31. Stage of water fluctuated, as regulated at spillway, reaching extreme height of 56.28′ above sea level on Nov. 29. From studies it appears that lake basin is subject to very little seepage or other underground losses. Records of Chagres River and tributaries show year 1912 to be second in order of dryness since U. S. occupation in 1904. Largest freshet since Dec., 1910, occurred Nov. 28 and 29, 1912; rise of 19.6′ at Vigia and 12.3′ at Alhajuela; discharge at latter point being 54,000 cubic feet per second.

Average temperature for year 1912 well above normal. Mar. warmest month at Ancon and Apr. at Culebra and Colon. Highest temperatures recorded Apr.—97° F. at Ancon and 96° F. at Culebra—established new high temperature records at these stations. Nov. coolest month at all stations, minimum recorded being 65° F. at Culebra.

Rainfall of 1912 below normal everywhere except immediately along Pacific coast, although generally heavier than annual rainfall for 1911. Heaviest precipitation 147.61″ at Porto Bello and minimum rainfall 71.78″ at Ancon.

Notable excess in wind movement in 1912. Average velocities abnormally high during dry season; maximum velocity of 49 miles an hour from the east recorded at Gatun. Prevailing direction was from northwest at Ancon and Culebra and from north at Colon. Relative humidity generally below normal, mean being 81 per cent at Ancon, 82 per cent at Culebra, and 83 per cent at Colon.

Number of seismic disturbances registered, but none so violent as to be sensibly felt in zone.

Surveys made of Miraflores Lake watershed, Corozal Hospital farm, Darien Radio Station Reservation for the Navy Department, Chagres River from Gamboa to the zone boundary to locate gravel banks, and area in vicinity of Mount Hope proposed for oil storage. Boundary line between city of Panama and zone run out and monuments located. Error of 100 meters found in recorded distance between triangulation stations Gamboa and Obispo, recorded distance being 1,093.34 and correct distance, 1,193.34 meters. Considerable survey work done for department of law and joint land commission. **P-13**, 44–48.

1914. Division in charge of A. L. Robinson until July 19, 1913. Subsequent to and until Mar. 6, 1914, Lt. Col. T. C. Dickson, U. S. Army, performed general duties relating to organization and personnel, while operation of shops under supervision of J. J. Eason. On Jan. 26, 1914, D. O. Nutting, U. S. Navy, reporting for duty, assigned as superintendent and took over all duties.

Establishments under operation by division consisted of Balboa shops (including roundhouse and car shops), Cristobal shops and dry dock, Paraiso shops.

Cristobal roundhouse, small hoisting establishments at Gatun, Empire, and Paraiso, and car-inspecting establishments at Cristobal and Balboa. Cristobal shops and dry dock charged with all repairs to floating equipment; this dock only one available when dry dock necessary, in continuous use. For docking 5 submarines on duty on Isthmus and for docking "Corozal," upper lock of east flight at Gatun used. Paraiso shops reestablished Oct. 22, 1913, for repairs on

dredging equipment in Culebra Cut. Hostling of 4 engines operating in this vicinity turned over to these shops May 25, 1914. Cristobal roundhouse turned over to mechanical division Apr. 1, 1914; all hostling at north end of canal concentrated there. The establishment, in addition to roundhouse, comprises a small boiler plant and 2 air compressors with capacity of 2,000′ per minute. Plant supplies air for hostling purposes and also for work on new piers of the Panama R. R. Small hostling plant established at Empire, in shops vacated, Mar. 1. With establishment of electrical division Apr. 1, 1914, electrical plants at Empire, Miraflores, Gatun, and Balboa, previously operated by mechanical division, turned over to that division; air compressors likewise turned over to electrical division. Old shipways shops at Pacific entrance turned over to mechanical division Oct. 22, 1913, and torn down in Mar. and Apr. Machine shops and engine house at Gatun operated for work in connection with installation of lock machinery and caring for locomotives engaged in that vicinity; abandoned Apr. 1, 1914, and work transferred to Balboa and Cristobal. Pedro Miguel engine house abandoned Sept. 15, 1913, and greater portion of equipment moved to Gold Hill engine house and buildings turned over to quartermaster's department and torn down. Engine house established at Gold Hill Sept., 1913, to care for equipment employed in dry excavation north of Gold Hill. Engine house continued in operation until completion of excavation work; discontinued Mar. 31, 1914. Air-compressor plant at Rio Grande, in operation since 1905, shut down Oct. 15, 1913, and such compressed air as was required in district previously supplied by Rio Grande furnished by plant at Empire. Cristobal car shops in operation until Mar. 7, 1914, when abandoned; car work concentrated at Balboa shops. When Balboa roundhouse put into service Apr. 1, 1914, Panama roundhouse of Panama R. R. placed out of use.

Throughout year, while shops in operation, 2 shifts regularly worked at Gorgona, Empire, Paraiso, and Balboa. In addition to double shift, emergencies necessitated overtime. **P-14,** 34, 35.

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  Report, **P-14,** 95.

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Meteorology Operations.
  1905. Division of meteorology and river hydraulics reorganized. Stations installed; men trained, looking toward systematic and correct reports. **P-05,** 117.

  1907. Division of meteorology and river hydraulics organized during fiscal year. Rain gauges established, system being reduced later to observing stations at about 12 places. Highest water in Chagres week ending May 12, rising 13′ in 14 hours at Gamboa and 12½′ in 16 hours at Bohio. Maximum discharge at Gamboa on Oct. 20, when river gauged 25,532 c. y. per second; on Apr. 3 it showed 417′ per second. Temperature 97°, minimum 67°, mean humidity 87.3°. No severe windstorms. Percentage of sunshine, 53. Only 1 earthquake noted by seismograph, slight only; no record of San Francisco movement. **P-06,** 113.

  1909. Organization: With resignation of Ricardo Arango, Sept. 18, 1908, because of ill health, division of river hydraulics and meteorology merged into the third division of O. C. E.
  Chagres River: Gauging continued at various stations; flow during dry season of 1908

lowest on record. Dry season of 1909 gave a discharge which was notably large; between Jan. 27 and Feb. 1 the largest freshet since the flood of 1906 occurred. First-class gauging stations established at Alhajuela, Bohio, Gatun River, Trinidad River, and Gatun; and river stations at Gamboa and Vigia. Three to eight hours' notice can be given of an approaching flood.

Meteorological stations: Three in operation; 22 rainfall stations, etc.

Earthquakes: Seismograph station completed, and instruments installed at Ancon. Tremors recorded of no greater frequency or magnitude than occur at Washington, D. C.

Surveys: Of Chagres River to more accurately determine its drainage area and run-off of adjacent territory.

Maps: Three general maps continued.

Trinidad River: Investigations begun of low divides at the headwaters of the Trinidad River, looking toward prevention of overflow thereat. **P-09**, 21.

1910. Division in charge of C. M. Saville, assistant engineer.

Gauging stations maintained at Gatun, Bohio, and Alhajuela, on Chagres River, Monte Lirio on Gatun River, and on Trinidad River. River stations maintained at Vigia and Gamboa for predicting floods.

Minimum flow at Bohio in Mar., 1910, when discharge was 1,220 cubic feet per second; maximum in Dec., when it reached 90,000 cubic feet per second. First freshet Sept. 14, when river reached elevation 61.6 at Gamboa. Crest of Nov. flood reached elevation at Gamboa of 72.6′ on Nov. 19, 1909, and at Gatun an elevation of 21.50 above mean tide, flooding area of 32.47 sq. m. Three floods occurred in Dec.; first reported from Vigia Dec. 6, due to rainfall in Chagres Basin above this station. Greatest flood of year began Dec. 26; river rose rapidly, and within 8 hours after beginning of rise at Vigia observer's house and water-stage register washed away. At Alhajuela crest of flood reached elevation 121, or 2′ higher than flood of Dec., 1906; at Gamboa it reached elevation 78.2,′ or 3′ lower than flood of 1906. Before high water of this flood had subsided another freshet occurred on 30th and 31st, crest of which reached elevation of 112′ at Alhajuela Floods interrupted operation of Panama R. R.; communication between Colon and Panama cut off entirely for 3 days.

Three first-class meteorological stations maintained at Ancon, Culebra, and Cristobal. Twenty rainfall stations also operated, 9 supplied with standard rain gauges and 11 with automatic registers of the tipping-bucket type.

Temperature for 1909 below normal, average being 78° F. at Cristobal and Culebra and 79° F. at Ancon. Minimum, 61° F. at Culebra on Mar. 1, 1910, and maximum at Culebra, Apr. 15, 1909, 94° F.

Rainfall for year greater at all stations; maximum at Porto Bello, where 237.28″ recorded. Maximum monthly rainfall at Porto Bello, Dec., 1909, registered 58.17″. Hail fell at Alhajuela on May 28, 1910. Deficiency of wind movement during year, though in storm at Ancon July 10, 1909, wind attained maximum velocity for 1 minute of 70 miles an hour, and for 5 minutes of 59 miles an hour, greatest velocity of record on Isthmus.

Slight seismic disturbances of frequent occurrence, very few of which physically observed in zone. Except in cases of minor local tremors, records at Ancon harmonize with records in U. S., Mexico, and Europe.

Careful record of evaporations at various points along line and the time of duration of fogs also kept.

Survey of watershed of Chagres completed.

Triangulation survey under way for combining all existing surveys for different parts of the work and tying them together in complete survey of zone. Nineteen new stations established which, with 3 existing survey stations near Colon wireless station, Colon Light, and Toro Point Light, comprise system from Atlantic to Pacific Oceans.

Investigations started previous year of low divides at headwaters of Trinidad to determine what steps, if any, should be taken to prevent overflow of lake continued. At one of the Cano saddles distance through the range at elevation 85 is 50′, and at no place between 90′ contours is it more than 100′. Investigation of this locality indicates it will probably be necessary to increase height, which can readily be done with material easily accessible. East of Gatun another saddle will probably require some reinforcement. **P-10**, 34-36.

1911. Gauging station maintained at Alhajuela on Chagres River, and hydrographer at this station had charge of the gaugings on upper and lower tributaries. Discharge measurements begun at Gamboa Nov., 1910, and continued. According to past records, elevation of river at Gamboa reached minimum during dry season of 1911, and discharge at this point less than on many previous occasions. Bohio abandoned as regular gauging station, though measurements of cross section taken from time to time to permit gaugings in times of flood. As entire run-off from Chagres Basin has passed through spillway since Apr., 1910, regular gaugings made at this point. Back water from Gatun Lake and construction of relocation of Panama R. R. at Monte Lirio interfered with permanent stations heretofore maintained on these rivers.

Vigia, Alhajuela, and Gamboa used as warning stations in times of freshets, and reports sent to construction divisions as soon as indications of rise in river noted.

According to discharge measurements at Gamboa, heaviest freshet Dec. 3, 1910, when there was a rise of 12.7′ and discharge was 57,200 cubic feet per second. Minimum flow at Gamboa during year on Mar. 31, 1911, when discharge was 700 cubic feet per second. Three first-class meteorological stations at Ancon, Culebra, and Cirstobal continued. There are also 3 second-class stations at Gatun, Pedro Miguel, and Gamboa, at which wind direction and velocity, temperature, and rainfall recorded. Twenty rainfall stations in operation, 12 equipped with standard and 8 with automatic rain gauges. At request of department of sanitation, anemometer erected at Corozal in Feb., 1911, for use in studies concerning mosquito migration. For determining effects of varied conditions on evaporation from lake surfaces, 3 evaporation pans, each equipped with standard rain gauge, and 2 of them with anemometers, installed in Gatun Lake in vicinity of Gatun, one in an exposed location in open part of lake about 1,000′ from shore, the second among the trees near lake border, and third in an extensive patch of tall rushes. Evaporation stations also maintained at Ancon, Cristobal, Rio Grande Reservoir, and Brazos Brook Reservoir. Automatic tide register installed in canal opposite Corozal, in addition to those in operation at Balboa and Cristobal. Two seismograph stations in operation for purpose of recording disturbances, one at Ancon and one erected during the year on Guarapo Island in Lake Gatun near spillway of dam, Apr., 1911.

Temperature for 1910 about normal for all stations. Highest, 94° F., at Ancon, Mar. 13, 1910, and lowest, 61° F., at Culebra, Mar. 21, 1910.

Average rainfall over zone well above normal, unusually heavy in July and Dec., but below that of previous year. For first half of fiscal year 1911 rainfall below normal. Dry season for 1910 above normal. Average rainfall for 1910, 90.83″ in Pacific section, 129.18″ in central section, and 157.86″ in Atlantic section. Average rainy days, 220 in Pacific section, 271 in central section, and 292 in Atlantic section; greatest number being 344 at Monte Lirio and the least 211 at Balboa.

Slight seismic disturbances of frequent occurrence.

Triangulation survey continued, primary scheme completed, 15 additional stations having been occupied. Secondary system established containing 42 additional stations. Triangulation scheme designed primarily to serve as framework upon which the lands survey could be hung, and majority of stations established in vicinity of important section corners. Adjustment of secondary system not completed at close of year. Original plan for survey of zone lands, for which specific appropriation made by Congress, contemplated laying out of lands of zone in quadrilaterals 2 kilometers on a side, referring lots and subdivisions to a system of rectangular coordinates. Southeastern part of zone, including most of territory between Las Cascadas and Panama city, surveyed with this in view. Expense such, however, that method was changed, as it was considered neither necessary nor advisable to secure accuracy attempted, and remainder of zone being surveyed with view of locating principal rivers, mountain ranges, trails, and roads with more topographic detail than the other method contemplated. Number of detailed surveys made for land office of Isthmian Canal Commission and Panama R. R. Co. after consolidation of offices effected.

Investigations continued during previous year of low divides at headwaters of Trinidad and Gatun Rivers continued until Jan., 1911; work completed. Section explored during year between Gatun and headwaters of Gatun River. Investigations included Canoa, Barro, and Egronal saddles. Results show ridges are of such thickness and composed of such materials as to permit no loss of water from Gatun Lake. At Canoa saddle, near headwaters of Trinidad, as reported previously, it will be necessary to construct dike or wall, and similar work will be required at headwaters of Las Guacas Creek, about half a mile east of Gatun. On account of location of the former, this work will not be attempted until waters of Gatun Lake are at sufficient elevation to enable easy access to the locality. **P-11,** 36–38.

1912. Third division of O. C. E., which formerly had charge of general surveys not embraced with the limits of any construction division, together with the meteorological and hydrographic work, abolished Jan. 24, 1912, when general survey work was practically completed. What remained of this, together with the collection of meteorological and hydrographic data, consolidated with second division of O. C. E. **P-12.** 1.

1913. See immediately above and below.

1914. Until Apr. 1, 1914, meteorological and hydrographic sections continued under separate heads; on that date consolidated into one division under chief hydrographer reporting to engineer of maintenance, and reduction of 3 "gold" men effected.

Wind records discontinued at Sosa Hill Jan. 1, 1914; wind station moved from Guarapo Island to administration building at Gatun Dec. 14, 1913; and new wind station established at Gamboa Nov. 11, 1913. Evaporation records at Brazos Brook discontinued Apr. 1, 1914. Rainfall station established on Siri branch of Trinidad River Jan., 1914, and similar station established near head of Gatun River branch of Gatun Lake May, 1914. Records from these stations obtained for use in estimating monthly rainfall over lake watershed. Seismic disturbances more numerous and severe than

in any previous year since American occupation, 87 distinct shocks being recorded at Ancon. Practically all shocks seemed to originate in vicinity of lower coast of Los Santos Province, 115 miles southwest of Ancon. Most violent shocks occurred Oct. 2, 1913, and May 28, 1914; in each instance maximum amplitude of 75+ recorded, when the recording pens were thrown off. Shock May 28 resulted in slight damage to new administration building, in course of erection at Balboa Heights; with this exception canal works suffered no damage. For use of Fortification Board, maximum and minimum temperatures recorded on Miraflores dumps. Duplicate automatic tide registers continued at Balboa and Colon.

Main hydrographic features of year were filling of Gatun and Miraflores Lakes and subsequent control of their water levels by spillway gates, auxiliary culvert valves, etc. Total yield of Gatun Lake watershed for calendar year 1913 was 77 per cent of yearly mean since May, 1908, and 70.3 per cent of mean for 24-year period 1890-1913. No large freshets during year.

Average temperature for calendar year 1913 slightly above normal. Apr. was warmest month at Ancon and Culebra and June was warmest month at Colon, 98° F. at Culebra on Apr. 24 established new high temperature record at that station.

Rainfall during 1913 below normal at all stations except Brazos Brook, Colon, and Porto Bello. Heaviest precipitation, 171.19" at Porto Bello, and minimum 59.54" at Balboa.

Wind movement over zone for year slightly above normal. North and northwest winds prevailed. Mar. windiest month at all stations, and Nov. month of least movement.

June 27 to Dec. 27, 1913, Gatun Lake level rose from plus 48.22 to plus 84.7. Since latter date has been controlled by spillway gates between 85.14 and 84.13. During year possible for first time to determine velocity which would be caused in prism at Gamboa by floods in upper Chagres. On May 26, with discharge at Alhajuela of 16,000' per second, velocity at Gamboa Bridge 0.65 mile per hour, lake level being at 84.92 and rising to 84.98. On June 30, with discharge at Alhajuela of 20,050' per second, velocity at Gamboa Bridge 1.05 miles per hour, with lake at 84.88 to 84.86. **P-14,** 26, 27.

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1905. Charge of the designing and construction of waterworks and sewers; care and maintenance of same; construction and repair of roads and works of a like character. 55 per cent of Panama waterworks completed. Ancon Reservoir practically completed. Temporary water supply of Colon in progress. Work being done at Ancon Hospital, La Boca, Culebra, Empire, Las Cascadas, Gorgona, Corozal, Paraiso, and Pedro Miguel. **P-05,** 110.

1906. Reports made on details of constructing Panama waterworks, sewers, paving; Colon water supply. Long and vexatious delays made in the furnishing of material; labor inferior also. Resignations and dismissals another source of delay. Work of the department a "great and satisfying success." **P-06,** 92.

1907. Paving of streets and construction of waterworks in Panama and Colon; paving, road making, grading, construction of waterworks and sewer systems, and other work in the zone; expenditure, $1,741,953, divided about equally between zone and Panama and Colon. Cost of work in cities named to be reimbursed to U. S. under a contract made after end of fiscal year; U. S. to collect water rates sufficient to reimburse itself. Cost of work to date for Colon and Panama, about $1,750,000. **P-07,** 7.

13,000′ water pipe laid in Panama; extensions mainly to outlying districts. Waterworks system in Panama complete. Connections made to 2,093 houses; average consumption, 20 gallons per person per day. 12,232′ sewer pipe laid; piping, etc., provided for storm sewers. Brick paving in city completed; streets made 2-team wide. Waterworks system in Colon complete. Sewerage system of Colon complete; 24,521′ pipe laid. Sump built, into which all sewage flows. House connections under way. Paving in Colon under way; marked progress made. Drainage system of streets under way. Road work at Ancon. Filtration plant, etc., added to waterworks system at Ancon. Piping laid, houses connected; sewerage provided for. Similar work of piping, etc., at La Boca, Corozal, Pedro Miguel, Paraiso. 16″ Venturi meter installed to measure water consumption from Rio Grande Reservoir, which has an available capacity of 248,230,000 gallons; plans made to increase this by 75,000,000 gallons. Crusher plant enlarged.

Culebra: Pumping station, daily capacity of 160,000 gallons, built; distilling plant placed in operation, supplying distilled water to Culebra and Rio Grande. Piping added, houses connected, standpipes built; sewers laid and connected; roads and paths built.

Camacho: Reservoir with capacity of 268,000,000 gallons completed. In Camacho and Empire water piping laid, standpipes built; sewers laid; roads built. **P-07,** 9.

Las Cascadas: 10″ mains put in; condensing plant installed to replace sterilizer; road built.

Bas Obispo, Chagrescito, Santa Cruz, and other places along the line of the canal: Water system installed; sewerage provided.

Gorgona: Storage capacity of Carabali Dam increased from 40,000,000 to 85,000,000 gallons. Condensing plant installed; fire system installed at machine shops; sewers for shops built; road built.

Tabernilla: Water service installed; also sewerage.

Gatun: 54′ main laid connecting all white quarters; distilling plant erected; fire protection installed; roads built.

Bas Obispo: Road built.

Cristobal and Colon: Mount Hope Reservoir completed; capacity, 435,000,000 gallons; pumping station constructed; filtration plant working. Roads and paths under way; 2 bridges built at cemetery. Water system extended at Cristobal, to cover docks, ice plant, bakery, laundry, etc.; sewerage extended; road work; open drains and catch basins built; fire plugs installed. **P-07,** 10.

Labor supply: Ample at all times. Average daily force, 2,593. **P-07,** 11.

1908. Duties: Completion of waterworks, sewage system, and paving in Panama and Colon; and construction of waterworks and sewage systems, paving, grading, and road making in the zone. Cost of work done, $1,067,150.52.

Cities of Panama and Colon: In Panama, 60,469′ water pipe laid, 2,093 houses connected; 67,925′ sewer pipe laid, 1,019 houses connected, and almost 90,000 sq. y. paving laid. In Colon, 69,280′ water pipe laid, 1,147 houses connected, 37,896′ sewer pipe laid, and 264 houses connected; nearly 70,000 sq. y paving laid; sewage sump provided.

Cost of city works: To Panama, $1,018,387.27; Colon, $894,275.17. Rental to be charged cities for auxiliary water system maintained by U. S. in zone; fixed rentals to be charged to credit of U. S. for water.

City works, maintenance: Sewers, waterworks and pavements of Panama and Colon transferred to division of public works, department of civil administration.

Panama and Colon, further works: Needed because of growth of some districts due to canal population, etc. Estimate, $1,000,000 (not to be undertaken without specific appropriation by Congress). **P-08,** 15, 16.

Canal Zone: 462,951′ of water pipe laid up to June 30, 1908; 2,320 houses connected. Water supplied from 4 reservoirs and 2 pumping stations; former at Rio Grande, Camacho, Gorgona, and Brazos Brook; latter at Tabernilla and Gatun. 12 additional pumping plants maintained as auxiliary and emergency units.

Rio Grande Reservoir: Capacity, 496,670,000 gallons; supplies water to all points south of Culebra, including Panama, Ancon, and La Boca. Annual consumption, 942,200,000 gallons (0.3 for city of Panama). All water for Panama and Ancon filtered at Ancon filter plant.

Camacho Reservoir: Capacity, 295,867,000 gallons. Supplies territory between Culebra and Bas Obispo. Annual consumption, 131,765,000 gallons.

Carabali Reservoir: Located back of Gorgona. Capacity, 80,000,000 gallons. Furnishes water for territory between Matachin and Mamei. **P-08,** 16, 17.

Brazos Brook Reservoir: At Mount Hope. Supplies from Mount Hope to and including Cristobal and Colon. Annual consumption, 457,544,000 gallons, with a capacity of 641,000,000 gallons.

Tabernilla pumping plant: Supplies water to territory between San Pablo and Frijoles. 500,000 gallons pumped daily.

Gatun pumping station: On Gatuncillo River. Pumps to Gatun. 1,200 gallons of distilled water daily.

Ancon Hill: For fire protection, to Ancon, Panama, and La Boca, 1,000,000 reserve storage reservoir to be built.

Locks, Miraflores and Pedro Miguel, water for: Surveys made of valley drained by Pedro Miguel River to ascertain extent of probable water supply for construction work. Daily flow of 674,000 gallons in dry season; ample.

Fires: Two at Panama and 2 at Colon; water service efficient.

Zone sewage: 98 per cent of all Isthmian Canal Commission quarters connected; 217,975′ at end of year, 2,163 house connections, 12 catch basins.

Roads: At end of year, 172,148′ macadam road built and 18,133′ paths laid.

Public works, Culebra Island: Waterworks, sewage system, walks, and landing stage built. Island used as a quarantine station.

Native settlements: Public works of various kinds constructed. Cost paid by Isthmian Canal Commission.

Rio Grande rock crusher: Delivered 57,329 c. y. broken stone. Cost, $1.75 per c. y.

Employees: 1,015 men on rolls at end of year.

Costs: System for keeping installed. Total cost of municipal works in zone, waterworks and sewers, $2,358,840.44; roads, etc., $1,174,778.26. **P-08,** 17, 18.

1909–13. (See Atlantic, Central, and Pacific divisions, respectively.)

1914. All municipal engineering work in zone formerly performed by construction divisions, as well as that performed in Colon and Panama by division of public works, department of civil administration, consolidated July 16, 1913, forming division of municipal engineering, under George M. Wells, resident engineer, reporting to chief engineer. **P-14,** 1.

Division divided into 5 principal sections: Northern district embraces all municipal construction, maintenance, and operation work, exclusive of operation of filtration plants, from and including Colon to Darien, 25.27 miles; southern district embraces similar work from Darien to Balboa, including city of Panama, 22.34 miles; waterworks for southern end of Panama Canal embrace construction of purification works at Miraflores, pumping stations at Gamboa, Miraflores, and Ancon, reservoirs, and laying of new mains; fourth subdivision embraces operation and care of purification plants and care and analyses of zone water supplies; and fifth subdivision embraces all work of design for division.

Improvements in Colon in progress at close of previous year being paid from appropriation by Congress of $800,000, completed in early part of Aug., 1913, at final cost of $520,212.57.

Plant at Gatun for manufacture of concrete pipe operated until May. Usual maintenance in connection with reservoirs of northern district performed, and level of water in Brazos Brook Reservoir kept at about same elevation during dry season by letting water from Gatun Lake through tunnel constructed during previous year. New purification plant located at Mount Hope and furnishing water to Colon, Cristobal, and adjacent district completed and placed in service Feb., 1914; has been successfully operated since. Total division cost of plant, $292,198.10.

In addition to maintenance in southern district a considerable amount of construction work undertaken, including streets, water and sewer systems, and roads in new silver town of La Boca, storm sewers in gold town site of Balboa, water and sewer systems and streets at Pedro Miguel, installation of water and sewer systems for Darien radio station, and work in connection with addition to Panama, for which Republic of Panama made special appropriation of $76,000.

Question of providing permanent, adequate, and suitable water supply for towns of zone from Pedro Miguel south under consideration for some time. Demands greater than could be supplied by Rio Grande Reservoir, and with depopulation of zone, contemplating elimination of all towns on west side of canal, plan prepared for utilizing Camacho and Rio Grande Reservoirs, connecting them by pipe line, and increasing capacity of Rio Grande Reservoir by raising dam, diverting railroad for purpose. With adoption of policy of quartering troops on west side of canal, utilizing old canal buildings for the purpose, together with fact that rainfall had not been sufficient to raise level of water in reservoir to full height, whole subject taken up anew Mar., 1913. Five projects presented; cheapest contemplated use of water from Miraflores Lake, and adopted. It contemplated laying of mains, construction of purification plant of the rapid mechanical gravity type on Miraflores Hill, and construction of high-service reservoir on side of Ancon Hill, all to be based on nominal maximum capacity of 12,000,000 gallons filtered water per day. At the time that use of Miraflores Lake water considered, possible objection advanced that chlorine content, by reason of operation of Miraflores Locks, might increase beyond 75 to 100 parts per million, but at the time it did not seem possible this would occur, at least for a period of years, on the assumption that intimate diffusion between salt water admitted by locks and fresh water of lake would not be rapid, especially in view of fact that water could be pumped from one of the fresh arms of the lake. At any rate, the enormous saving that would result seemed to warrant adopting Miraflores Lake project.

In Jan., after pumps from Cocoli had been transferred to Miraflores and increased in capacity to take care of demand, chlorine sampling stations established in lake; discovered that with continued operation of locks chlorine content steadily rose. By Feb. it became apparent that constant diffusion taking place throughout all areas of lake in general, as high as 15 per cent salt water. To bring this down, temporary pump station installed at Pedro Miguel and approximately 4,000 gallons of water per minute pumped from Culebra Cut north of locks and discharged into Miraflores Lake immediately in front of temporary pumping station. This reduced chlorine content going to Panama, but it increased turbidity of water due to condition in cut. As result of these observations, it became evident that Miraflores Lake would be impracticable for use as source of water supply for southern end of canal, and it was decided to move pumping station to Chagres River at Gamboa, water to be taken from this point through 30" to 36" cast-iron mains laid along line of Panama R. R. to purification plant on Miraflores Hill. Before final action taken, effort made to reduce chlorine content by drawing off water from Miraflores Lake through locks and admitting fresh water through Pedro Miguel Locks, but results not satisfactory. Work commenced on purification plant, Miraflores Hill, Aug. 1, and steam shovel and hand excavation completed Jan. 28 by removal of 91,233 c. y. For high-service reservoir at Ancon there were laid 1,477 c. y. reinforced concrete, and in purification plant, Miraflores Hill, there were laid 5,656 c. y. reinforced concrete. Total expended for new waterworks in southern district estimated at $1,261,000. Total amount expended at close of year, $703,585.05. **P-14,** 23–26.

Municipalities. (See Atlantic Division; Central Division; Pacific Division; Water Supply; Waterworks; Sanitation; Civil Administration; see Nos. 45, 52, 121, pp. 2362, 2363 of this Index.)

Division of municipal engineering, **P-07,** 59; **P-08,** 80; **P-14,** 90.

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Work, central division, **P-09,** 85; **P-10,** 157; **P-11,** 153; **P-12,** 167; **P-13,** 156.

Work, Pacific division, **P-09,** 103; **P-10,** 80, 192; **P-11,** 174, 187; **P-12,** 188, 201; **P-13,** 180.

Municipalities, operations.

1905. Oct. 24, 1904, legislative enactment of the Isthmian Canal Commission established 5 municipal districts in the zone. Area, 475 sq. m. Population, embracing everyone, estimated at 25,000. Officers of local government, a mayor, judge, secretary, and a treasurer, who are appointed, and whose salaries are fixed by the governor of the zone. Each municipality has a council of 5 members, appointed by the governor of the zone upon the recommendation of the mayor. Various public works projected and in progress under the auspices of the municipalities, such as courthouses, slaughterhouses, etc. Liquor-license tax increased from about $2.50 to $10 per month to $600 gold annually, increasing revenues and reducing disorder, wiping out disreputable places. **P-05,** 71.

1906. Great amount of public work done; finances have improved, and respect and admiration of inhabitants of zone gained. Satisfaction over fact that taxes are not all spent for maintenance of the central government. Slaughterhouses, market houses, schoolhouses, municipal buildings, sidewalks, lighting systems, jails, parks, opening of roads and trails some of the work done. Compulsory attendance of children between 6 and 12 at school increased attendance from 20 to 40 per cent. Cash balance to credit of municipalities of $145,291.29 silver, as against $61,054.01 Sept. 30, 1905. **P-06,** 37.

Municipalities, Tropical.

Properties, low value of, **P-04,** 82.

Murders. (See Orders, Executive.)

N.

Natives.
  Zone government gaining respect of natives of Panama, **P-05**, 28.

Navigation, and Aids to, P-11, 84; **P-12,** 101; **P-13,** 106; **P-14,** 27. (See No. 215, p. 2365 of this Index.)
  Beacon, Culebra Cut, **P-14,** pl. 62.
  Central plant for making aids to navigation, **P-12,** 104.
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  Equipment, **P-13,** 108.
  Gas buoys, **P-13,** 108.
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  Illuminants in aid of, **P-12,** 104.
  Laws, **P-14,** 263.
  Licenses, **P-14,** 266.
  Surveys, aid to navigation, **P-13,** 108.

Navigation, Operation.
  1914. Construction and placing of lights and beacons continued. With exception of light at extremity of west breakwater and construction of 6 which can not be placed until work in connection with slides in Culebra Cut is completed, all aids to navigation finished and turned over to superintendent of canal transportation, for maintenance and operation, June 16, 1914. Design for west breakwater light was for rather elaborate structure founded on a caisson built during previous year. Taken to site, but in sinking it valves could not be controlled and caisson sunk. After expending $8,602.22 in attempt to straighten caisson it was abandoned, as was also the design. Total expended in completing entire system of beacons, lights, and buoys to date, $514,878.81, exclusive of general expenses. **P-14,** 27, 28.

Navy.
  Act relating to compensation to retired officers and men, **P-11,** 573.
  Appropriation for marine quarters, zone, **P-13,** 607.
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  Visit of Atlantic Fleet, **P-13,** 559.

Negroes. (See Labor; Kitchens; Messes.)
  Quarters, family, **P-07,** 96, pl. 117.
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Netherlands. (See No. 164, p. 2365 of this Index.)

New Panama Canal Co.
  Act, purchase of rights, **P-11,** 549.

Nicaragua. (See Nos. 6, 12, 21, p. 2361 of this Index.)

Noble, Alfred. (See Nos. 1, 164, 208, 213, pp. 2361, 2365 of this Index.)

Notaries, etc.
  Executive order relating to, **P-12,** 612.

Nurses. (See No. 98, p. 2363 of this Index.)
  Quarters, **P-07,** 96, pls. 112, 113; **P-10,** 434, pl. 68.
  Sisters of St. Vincent de Paul replaced; latter ignorant of American tongue and methods. Sisters removed at expense of U. S. to other countries. Some assigned to duty at Santo Tomas Hospital, under joint authority of U. S. and Panama. **P-05,** 52.

Nutting, D. C. (See No. 265, p. 2368 of this Index.)

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Ocean. (See Meteorology.)
  Lower guard gates ready for entrance of Atlantic waters, Gatun, **P-13,** 110, pl. 1.
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  Civil administration, **P-12,** 457; **P-13,** 461.
  Organization, **P-11,** 415.

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  Engineer work, **P-08,** 201.

Officers.
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Officers, Retired.
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Officers, United States.
Bonds, act relating to, **P-11,** 574.

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Cristobal, **P-07,** 104, pl. 120.
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Administration building at Panama growing inadequate. Other quarters acquired as needs grow. Plans made for other locations for administration buildings. **P-05,** 52.
Panama office buildings inadequate. New ones planned for other locations. **P-05,** 119.
Headquarters of the zone government at Ancon. Various buildings in construction for department offices. **P-06,** 26.

Offices, Washington. (See No. 227, p. 2366 of this Index.)
Moved to larger building, **P-05,** 5.

Oil.
Deposits, zone, **P-13,** 579.
Oiling and macadamizing roads, fifth division, **P-13,** 183.

Oil, Fuel. (See Fuel.)
Consumption, **P-09,** 82, 102; **P-10,** 156; **P-11,** 151; **P-12,** 166; **P-13,** 155.
La Boca dredging division, **P-08,** 54.
Plants, **P-14,** 194.
Terminals, **P-12,** 217; **P-13,** 218.

Oil Pipe Line. (See No. 84, p. 2363 of this Index.)
Union Oil Co. of California granted concession for pipe line over land owned by Isthmian Canal Commission and Panama R. R. Similar concession gained from Panama Oct. 30, 1906. License revokable; $500 a month to be paid to zone treasury for benefit of special fund for schools. Isthmian Canal Commission and Panama R. R. may purchase oil for 90 cents a barrel. **P-06,** 22.

Opening.
Of canal, act, **P-12,** 599.

Operation and Maintenance of the Canal, P-14, 63.
1899–1901. Data obtained from famous canals; i. e., Suez, Manchester, Kiel, etc. Cost of maintenance and operation of Suez; of Kiel and Manchester Canals; of St. Marys Falls Canal. Maintenance and operation of Nicaragua Canal much greater than for Panama Canal. Former has 4 times the total length of the latter. Has more locks, weirs, etc. Greytown a most difficult harbor to maintain, and is in region of greatest rainfall. Annual cost, for Nicaragua, $3,300,000; for Panama, $2,000,000. Commission d'Etudes, using a different methop, estimated the cost for the Panama route at $1,940,000. **P-99,** 169, 170.

1911. As work nears completion, it is intended to concentrate construction until what remains will be in immediate charge of directing office, thereby reducing costs and overhead charges. Believed that more satisfactory operating force can be secured by selection of suitable men from "present" organization. There has been considerable criticism because of high wage scale, but this due to fact it was difficult to obtain men when work started, on account of bad reputation of country, and also because of temporary character of the work. Complaints made constantly because salaries disproportionate to responsibilities, and because of lack of uniformity in percentage of excess over wage scale for similar labor in States. After inauguration of scale it was not considered advisable to make reduction, and rearrangements made from time to time as necessities required, but inequalities still exist. Conditions different now. Chief sanitary officer declares death rate of zone to be "much lower than that for most parts of the U. S.," and general health of about 8,000 white Americans in the zone to be "fully as good as it was in the U. S.;" also, continuance in employment can be assured. Believed that lower wage scale can be put into effect for operating canal, and that necessary force can be secured from men who will remain in service during next year or two. This an important consideration, since it is essential that cost of operation shall be reduced to minimum consistent with efficiency. With operating organization provided for, steps can be taken to adopt salary and wage scale, after which there can be created from construction force one for operation without delay or confusion.
Total outlay for maintaining the canal will be for wages of force engaged in its operation, expense of engineering work connected therewith, and cost of sanitation and civil administration.
Revenues of canal should go to pay not only operating expenses, but to repay capital invested. Every legitimate means for increasing revenue should therefore be adopted. U. S. should have coal and fuel oil on hand for its own vessels, and these commodities should be sold to shipping using the canal. These should be supplied at established rate and purchased after advertisement. Existing commissary, manufacturing plant, and laundry should be continued for the benefit of U. S. forces and to furnish supplies and service to shipping. Wireless-telegraph station should be established for commercial as well as military purposes. Canal authorities should be authorized to sell tools and appliances needed by ships, and to make repairs as may be necessary while ships in vicinity of canal. Dry dock should

be built with dimensions conforming to locks. Both dry dock and machine shops would be available for use by Navy. If this policy be adopted, early legislation needed that construction necessary to make it effective may be undertaken without delay. **P-11**, 60–63.

1914. As already outlined, organization made effective Apr. 1, 1914, provided for department of operation and maintenance under governor, who was to be assisted in the administration of the department by engineer of maintenance and superintendent of canal transportation. Capt. H. Rodman, U. S. Navy, appointed superintendent of canal transportation, and charged with safe conduct of vessels through Panama Canal, except at locks. Also given supervision of port captains, board of local inspectors, pilots, operation of lights and beacons subsequent to June 15, and inspection and admeasuring of vessels. Offices of captains of ports at Cristobal and Balboa established May 5; charged with duty of assignment of wharves, docking and berthing of vessels, furnishing of pilot service to shipping, admeasurement of vessels for transit through canal, and general supervision and enforcement of canal and harbor regulations relating to shipping. Eight pilots appointed—four at each end; their services have been utilized in piloting vessels in and out of terminal ports, in connection with lightering cargo through canal, familiarizing themselves with aids to navigation and with canal route.

Due to condition of affairs in Mexico and interruption of the Tehuantepec route, demands upon Panama R. R. for transshipment of freight became so great that it was necessary to institute barge service through canal; this made effective on May 15, when barges were towed through canal from Colon to Balboa, and continued rest of year. Tolls paid by Panama R. R., and aggregated for year $11,610.69.

Maintenance work undertaken at locks covered miscellaneous repairs, as well as care necessary to keep machinery in satisfactory working order. Maintenance charges made applicable only after work had been entirely completed in each instance. Amount expended for such repairs and maintenance work, $120,287.99. Heavier expenditures were at locks and were incurred in connection with gates, emergency dams, miter gate moving machines, rising stem valve machines, cylindrical valve machines, and in lighting. Work done in repainting gates, caissons, and caring for machines of spillways. Also expended $16,570.44 of amount above noted for maintenance in clearing vegetation and pulling trees from canal channel, and removing timbers and driftwood from vicinity of locks. **P-14**, 63, 64.

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- Isthmian Canal Commission, duties of, defined more clearly; several existing orders combined by Executive order of Jan. 6, 1908; certain details transferred to the chairman, **P-08**, 1.
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- **1905.** Isthmian Canal Commission No. 3 organized under Executive order of the President and of the Sec. of War, Apr. 1 and 3, 1905.
- Contents of order: Practical result of preceding commission not satisfactory. Isthmian Canal Commission No. 3 charged with the general duty of the adoption of plans for the construction and maintenance of the canal and with the execution of the work of the same; with the purchase and delivery of supplies, machinery, and necessary plant; the employment of the necessary officers, employees, and laborers; and with the fixing of their salaries and wages; with the commercial operations of the Panama R. R. and its steamship lines as common carriers; with the utilization of the railroad as a means of constructing the canal; with the making of contracts for construction and excavation; and with all other matters incident and necessary to the building of a waterway across the Isthmus of Panama, as provided by the act of June 28, 1902. Executive committee to act for the commission during the intervals between the regular quarterly meetings. There shall be three executive departments: (a) Fiscal affairs, purchase and delivery of materials and supplies, accounts, commercial operation of railroad, etc.; (b) government of zone, sanitary matters; (c) construction plant, operation of railroad, etc. Officers and employees to be appointed generally by their respective department heads. Contracts to be essentially competitive. Board of 9 civil engineers to be appointed by the President to cooperate with the Isthmian Canal Commission No. 3. **P-05**, 2, 3.
- Isthmian Canal Commission No. 3 assumed office Apr. 3, 1905, **P-05**, 1.
- Members Isthmian Canal Commission No. 3: Theodore P. Shonts, chairman; Charles E. Magoon, governor of zone and member; John F. Wallace, chief engineer and member; Rear Admiral Mordecai T. Endicott, U. S. Navy; Brig. Gen. Peter C. Hains, U. S. Army (retired); Col. Oswald H. Ernst, Corps of Engineers, U. S. Army; Benj. M. Harrod, **P-05**, 4.
- Salaries: $7,500 per annum; chairman, $22,500 additional; chief engineer, $17,500 additional; governor of zone, $10,000 additional. Foregoing officers to have use of furnished dwell-

ing house on Isthmus. Travel expenses for all members. **P-05,** 5.

Secretary, Joseph Bucklin Bishop; appointed Sept. 7, 1905, **P-05,** 5.

Well fitted to accomplish what was intended, **P-05,** 109.

Chief Engineer John F. Stevens, appointed July 1, 1905, **P-05,** 108, 123.

The following divisions were found in operation on Mr. Stevens assuming charge, July, 1905: Colon construction division, Chagres division, Gamboa division, Culebra division, La Boca division; and bureau of personnel, transportation, and quarters, of supplies, of waterworks, sewers and roads; of machinery and equipment, of architecture and building, of meteorology and river hydraulics, of map making, lithography, and printing; and bureau of communication (telephones and telegraphs, etc.), **P-05,** 124.

Department of construction and engineering: Secretary of chief engineer; assistant chief engineer; manager of labor and quarters, **P-05,** 151.

Superintendent of motive power and machinery; architect; master builder, **P-05,** 152.

Principal assistant or assistant engineers; office engineer; division engineers; mechanical engineer, **P-05,** 153.

Executive department: Charles E. Magoon, member of Isthmian Canal Commission No. 3, governor, **P-05,** 27, 107.

Act 8, Laws of the Canal Zone, established the executive branch of the zone government, created the office of governor, and provided for the following departments: Executive, health, revenues, justice, police and prisons, treasurer of the zone, and auditor of the zone, **P-05,** 29.

Department of health: Col. W. C. Gorgas, chief sanitary officer, **P-05,** 107.

Judicial department (supreme court): F. Otis Duran, chief justice; Hezekiah A. Gudger, associate justice; Lorin C. Collins, associate justice, **P-05,** 107.

Duties of the head of the department of government and sanitation of the Isthmian Canal Commission No 3, and governor of the Canal Zone: Defined by order of Apr. 1, 1905, of President. He shall administer and enforce the laws of the zone, supervise all measures of sanitation within the zone and the cities of Panama and Colon, act as custodian of supplies required for sanitary purposes, and perform such other duties as he may be charged with by Sec. of War. **P-05,** 28.

Treasury: Paymaster G. C. Schaefer, U. S. Navy, treasurer, **P-05,** 107.

Washington office: Organized Apr. 3, 1905. Chief of office appointed, Col. C. R. Edwards, U. S. Army. Sections or divisions: Central office, or office of administration proper; office of general auditor; general purchasing officer; disbursing officer; committee on engineering, **P-05,** 148.

Col. Edwards resigned as chief of Washington office, Nov. 15, 1905, **P-05,** 150.

Duties of chief of Washington office assigned to assistant chief, **P-05,** 150.

1906. Reorganization: The President, Nov. 17, 1906, during a visit to Panama, amended Executive order of Apr. 1, 1905, to divide the work of the project among the following departments: Engineering and construction, law and government, sanitation, auditing, purchasing, disbursing, and labor, quarters, and subsistence. Head of each department made directly responsible for the work carried on under his direction. All appointed by and report directly to the chairman of the Isthmian Canal Commission No. 3, who, in turn, is responsible to the President through the Sec. of War. **P-06,** 15.

Executive committee abolished, legal and governmental departments consolidated, separation of sanitary department from governmental department. In the absence of the chairman, the chief engineer acts in matters requiring immediate attention. **P-06,** 16.

Executive order of Apr. 1, 1905, changed Nov. 17, 1906, to provide: Quarterly sessions of the Isthmian Canal Commission (4 members a quorum) on the Isthmus; with general charge of all operations incident to the building of an Isthmian Canal at Panama, including sanitation, local government, etc.; executive committee of Isthmian Canal Commission abolished.

General organization: Chairman, chief engineer, general counsel, chief sanitary officer, general purchasing officer, general auditor, disbursing officer, and manager of labor and quarters.

Besides being in general charge, the chairman shall appoint the heads of the various departments, subject to the approval of the Isthmian Canal Commission; the head of each department shall report to and receive instructions from the chairman; he shall have charge of the operations of the Panama R. R. and steamship lines.

The chief engineer shall have charge of all engineering work relating to the canal, etc.; all construction work on the Isthmus; operation of Panama R. R. so far as it relates to canal work; the custody of all the supplies and plant of the Isthmian Canal Commission on the Isthmus. He shall act, in absence, for the chairman.

The general counsel shall have charge of all legal matters pertaining to the Isthmian Canal Commission; the administration of civil government within the zone, exercising through a local administrator the authority heretofore vested in the governor of the zone.

The chief sanitary officer shall have charge of all matters of sanitation within the zone, and also in the cities of Panama and Colon, and the harbors, etc., between the U. S. and Panama; the custody of all medical supplies needed for sanitary purposes.

The general purchasing officer shall have charge of the purchase and delivery of all supplies, machinery, and necessary plant.

The general auditor shall have charge of the general bookkeeping, of property accounts, of statistics, of administrative audit of the Isthmian Canal Commission, and of the accounting, bookkeeping, and audit of the government of the zone.

The disbursing officer shall have charge of the timekeeping, of preparation of time rolls and vouchers, and payment of the same.

The manager of labor and quarters shall have charge of the employment of all necessary labor; of record of employees; quarters, assignment of same to employees or contractors; and operation of all Isthmian Canal Commission hotels and mess houses.

Appointments: All officers and employees shall be appointed and their salaries fixed by the respective heads of the departments, subject to the later approval of the Isthmian Canal Commission. Contracts for labor shall be negotiated by the chairman of the Isthmian Canal Commission, where the contract is made in the U. S. Employment of labor upon the Isthmus or outside the U. S. shall be conducted under the supervision of the chief engineer, subject to the approval of the chairman.

Contracts: Amounting to over $10,000, by public advertising; award to lowest responsible bidder. More than $1,000 and less than $10,000, competitive bids by invitation or advertisement whenever practicable.

Reports: Head of departments to report to the Isthmian Canal Commission, as may be required; chairman to report to Sec. of War; Sec. of War to report to President. **P-06,** 151–153.

1907. (See No. 217, p. 236, this Index.)

1914. Effective Apr. 1, 1914, by Executive order and in conformity with Panama Canal act Aug. 24, 1912, "existing" organization abolished and one contemplated by act made effective. Under this there were created department of operation and maintenance, purchasing department, supply department, accounting department, health department, executive office, and Washington office.

Department of operation and maintenance placed in charge of governor, and in administration of affairs of department he is assisted by an engineer of maintenance and a superintendent of canal transportation. To provide for remaining construction work as well as maintenance and operation of canal, department organized with following divisions:

Division of terminal construction, which embraces charge of design, inspection, and construction of dry docks, shops, coaling and fuel-oil plants, floating cranes, docks, and other terminal facilities; construction transportation by rail; road, street, and sewer work in new town of Balboa; and breakwater construction at Atlantic terminal, reporting to governor.

Division of erection; electrical division; division of municipal engineering; division of lighthouses (until June 16, 1914, when it was abolished); and office engineer with his forces, placed under engineer of maintenance.

Dredging division, fortification division, mechanical division, and remaining construction work, consisting of sluicing in vicinity of Gold Hill, completion of Naos Island Breakwater, excavation in dry to relieve side pressure in vicinity of Culebra, and grading and filling at locks and dams, combined in general construction division, report directly to governor.

Division of canal transportation, under supervision of superintendent of transportation reporting to governor is charged with safe conduct of vessels through canal. Port captains, board of local inspectors, pilots, and admeasurers of vessels, and, since June 16, 1914, care and operation of lights and beacons, directly in charge of superintendent of transportation.

Col. H. F. Hodges, U. S. Army, designated as engineer of maintenance; H. H. Rousseau, U. S. Navy, as engineer of terminal construction; and Capt. H. Rodman, U. S. Navy, as superintendent of transportation.

Quartermaster's department and subsistence department, consolidated to constitute supply department, placed in charge of Capt. R. E. Wood as chief quartermaster. Has charge of storing and distribution of all material and supplies for use of Panama Canal and its employees, and for other departments on Isthmus and their employees, and for vessels of U. S. and other vessels when required. Operates commissaries, hotels, and messes; has charge of maintenance of buildings, assignment of quarters, and care of grounds. Recruits and distributes unskilled labor and is in charge of necessary animal transportation.

Accounting department, as organized, consists of auditor's, paymaster's, and collector's offices. Consolidation made for administrative purposes only, to secure economy, auditor having supervision and direction of entire department; heads of subdivisions are independent in their own particular spheres. Department has charge of general bookkeeping, auditing, and accounting for both money and property, examination of pay rolls and vouchers, inspection of time books and of money and property accounts, administrative examination of accounts as required by law, and collection, custody, and disbursement of funds for Panama Canal and zone. Accounting department placed in charge of H. A. A. Smith as auditor for Panama Canal, with J. H. McLean as paymaster and T. L. Clear as collector.

Health department organized under supervision and direction of a chief health officer,

Lt. Col. C. F. Mason, U. S. Army. Department charged with all matters relating to maritime sanitation and quarantine in ports and waters of zone and in harbors of cities of Panama and Colon, and with land sanitation in zone and sanitary matters in terminal cities in conformity with canal treaty between U. S. and the Republic, together with all matters relating to hospitals and charities.

Civil functions of zone placed in charge of executive secretary who, under direction of governor, has supervision of all matters relating to keeping of time of employees, to post offices, customs, taxes and excises, excepting collection thereof, police and prisons, fire protection, land offices, schools, clubs, and law library, custody of files and records, and administration of estates of deceased and insane employees. He conducts all correspondence and communications between authorities of zone and Republic and diplomatic representatives from other countries. C. A. McIlvaine appointed executive secretary.

Scope of work of Washington office remained about the same as previously reported, Maj. F. C. Boggs, U. S. Army, being continued in charge as general purchasing officer and chief of office.

By Executive order May 20, 1914, committee of 6 members created to arrange and provide suitable ceremonies for formal and official opening of Panama Canal, as provided for in section 4 of Panama Canal act. Committee composed of persons who were members of Isthmian Canal Commission and is to be known and referred to as committee for formal and official opening of Panama Canal.

Outlets, Locks.

Study for, Gatun Lock, **P-11,** pls. 94, 95, 96, 97.

Output. (See Dredges.)

Overtime.

Shops, **P-11,** 221; **P-12,** 260; **P-13,** 257; **P-14,** 255.

Oxy-acetylene Plant.

Locomotive department, **P-11,** 236.

P.

Pacific Division. (See Nos. 242, 255, 256, pp. 2367, 2368 of this Index.)

Panoramic view, **P-09,** 134, pl. 68.

Pedro Miguel to Panama Bay, **P-10,** pl. 107.

Pacific Division, Operation. 1905. Canal work delayed by quarantine. Miscellaneous survey work done, etc. **P-05,** 13.

1906–1909. (See Nos. 125, 219, 220, 221, pp. 2364, 2366 of this Index.)

1909. Duties: Construction of locks and dam at Pedro Miguel, at Miraflores; Ancon quarry work; sand supply at Chame; dredging and excavating channel between the locks and below Miraflores Locks to deep water in the Pacific; and such municipal, building construction, and sanitary work as required by the district. District takes in the former La Boca dredging, and Pacific Locks and dams divisions.

In charge: S. B. Williamson, as division engineer. **P-09,** 15.

Pedro Miguel; foundations of locks: Durable rock of ample strength; no underlying water-bearing strata. Rock of such quality that portion will be left in place under the central culvert to form part of the separating wall between the lock chambers; this core will be faced with concrete.

Culverts: Later culverts will be built in trenches; lock floors connecting them will be 1′ thick.

Excavation, locks: Continued during the year; total amount removed, 715,726 c. y. (167,061 c. y. used to construct rock toes of the dam).

Results of work to date: Completion of west lock chamber to grade; and of east lock chamber, excepting about 45,000 c. y. to be removed.

West dam: To be of earth, connecting the lock with the hill to the northwest; about 1,400′ long; reference of top at 105; top width 50′, and side slopes approximately 8 to 1. Maximum pressure that from head of 40′. Two rock piles are formed of spoil from lock excavation; puddled clay between. Maximum thickness at bottom of this clay core, 140′. Material underlying dam impervious generally.

Approach piers: Character undetermined.

East lock wall: To be turned toward hill on east and connected thereto, by concrete core wall resting on rock 550′ long, 4′ thick on top, and 10′ thick at bottom.

Drainage: Dike made across south end of lock site to keep out tide water; pumping plant installed to take care of seepage, etc. **P-09,** 15, 16.

Miraflores; lock site excavation: Continued by steam shovels in the upper locks and by a suction dredge. Total removed, 1,147,527 c. y. (about half the total estimated quantity). Of this amount, 307,060 c. y. placed in toes of

the dam, and 239,400 c. y. for fills for construction purposes.

Plans for dams: Adopted and approved during the year. West dam to extend from head of the lock to Cocoli Hill; will dam the Cocoli River (discharge of which will be thrown into Lake Miraflores). Dam to be built of 2 rock piles, as at Pedro Miguel. Will rest upon impervious material; cored to lock walls and Cocoli Hill with concrete. Length, 2,300′; top width, 40′ at reference 70; side slopes approximately 12 to 1. Average head to which dam will be subjected, 30′; maximum, 45′. Plan of east dam approved; details not completed. Of concrete on rock; 500′ long; with regulating works as at Gatun; crest at elevation 39. Openings will permit of discharge of 75,000′ per second.

Approach piers of locks: Under study.

Locks: Of concrete. Quarry for stone opened on west side of Ancon Hill. Crushing plant being installed; capacity, 2,500 c. y. daily. Sand to be procured with suitable plant from Point Chame, 23 miles west of Balboa. Cement shed built on west side of Miraflores Locks, having a capacity of 75,000 barrels. Construction plant for locks under contract. Four berm cranes and four chamber cranes. **P-09,** 16, 17.

Channel excavation, Pedro Miguel to Pacific deep water: 1,279,600 c. y. to be removed (63,600 c. y. rock) between Pedro Miguel and Miraflores; between Miraflores and deep water in Pacific, 13,000,900 c. y. loam and 1,725,000 c. y. rock. Because of tidal oscillations, etc., decided to remove all rock between the locks and for 2 miles below Miraflores, in the dry. Temporary dam to be placed about 2 miles below Miraflores locks to permit dry excavation. This would leave below the temporary dam about 3,600,000 c. y. of loam and 123,000 c. y. rock, to be removed by dredging, etc.

Dredging: Fleet consisted of 1 seagoing suction, one 20″ suction and pipe line, one 5-yard dipper, and 4 French ladder dredges. 8,475,931 c. y. dredged from the channel proper, completed for about 5 miles from deep water in the Pacific.

Marine shops: At Balboa, maintained. Repairs made to plant; new equipment erected.

Municipal, sanitary, and building work: 1,000,000 capacity concrete reservoir built at Ancon Hill to replace smaller tank. Alterations made in Ancon pumping and filtration station. Considerable work done in changing the water main from the Rio Grande Reservoir to permit the excavation of the locks at Pedro Miguel; various pipe connections made.

Roads: Constructed under the direction of the department of civil government from Panama to Corozal, and from Paraiso station to Pedro Miguel.

Buildings: 23 begun in previous year finished; were entirely erected by day labor, and 4 under contract. Repairs, etc.

Sanitary work: Digging and cleaning ditches, laying concrete and tile drains, and filling swamp lands. **P-09,** 15-18.

1910. Work in division consists of construction of locks and dam at Pedro Miguel, locks and dams at Miraflores, Ancon quarry, dredging sand at Chame, excavating channel between locks and below Miraflores Locks to deep water in Pacific, such municipal work as may be required within territorial limits of division, and such sanitary engineering work as may be prescribed by sanitary department within same area. Work in charge of S. B. Williamson, as division engineer.

Pedro Miguel: Work continued excavating lock site and approaches thereto from south. When excavation nearly completed two slides on east side, delaying work and increasing amount to be removed by 75,299 c. y. Total excavation during year, 277,935 c. y. by steam shovels, and 65,513 c. y. by hand, of which 44,948 c. y. classed as preparing foundations.

Subsequent to completion of steam-shovel work preparation of foundations for reception of concrete undertaken by removing loose rock which remained and by excavating 42 trenches, 13′ wide, 11′ deep, and 137′ long for lateral culverts, and an area of 2,500 sq. f. to 5′ below floor level at miter sills. Greater portion of material handled by pick and shovel into buckets or skips, which were unloaded into cars by locomotive cranes or derricks. Small portion handled directly into cars by Thew shovel. In preparation of foundations 64,084 c. y. removed.

Bids invited for lock construction plant Oct. 8, 1908. Largest amount of concrete in division to be laid at Miraflores, and while in the selection of plant economical handling of this material was guiding consideration, another factor was that plant should be capable of being adapted to work at Pedro Miguel. Cantilever cranes adopted, general description given in report for 1909. Contract entered into with Wellman-Seaver-Morgan Co., Cleveland, Ohio, May 8, 1909, for furnishing material and assistance in erection. One arm of berm cranes will transport material from storage piles to mixers on cranes. Product will be passed by boom arms to side walls or to chamber cranes in locks, which will place concrete in center walls. Both berm and chamber cranes will handle forms and steel or cast iron embedded in the concrete.

At Pedro Miguel banks adjacent to lock pit are such as to prevent berm cranes from functioning as at Miraflores, so they are arranged with two cantilever arms, placed in forebay of locks, and used solely for transporting material from stock piles to mixers and for mixing. Chamber cranes place the mixture in both side and center walls, as well as handle all forms and steel or iron work. Concrete is carried from mixers by narrow-gauge construction locomotives hauling two flat cars, each carrying 2-yard bottom-dump bucket, which is taken by chamber crane and concrete deposited in the walls.

Contract required delivery of one berm and one chamber crane by Aug. 20, and one berm and two chamber cranes by Sept. 20, 1909. Due to causes beyond control of contractor deliveries delayed, and as cement deliveries were based on dates noted, when advised of delays, arrangements made to install mixers for building lower guide or approach wall and for laying concrete in floors in advance of receipt of construction plant. To this end three ½-yard mixers employed in approach walls, and two 2-yard mixers installed temporarily, one on east and one on west side of lock pit, for laying lateral culverts and floors.

First berm crane delivered Oct. 10, and first chamber crane Oct. 25, 1909, but erection interfered with by excessive rains, so that it was not until Apr. 4, 1910, that one-half of regular plant was installed and began laying concrete in west and center walls. Temporary mixer on west side then dismantled, but one on east side continued in service until close of year. Entire construction plant at Pedro Miguel began operations July 15.

Storage trestles in forebay of locks constructed on both sides of and parallel to canal axis, each having height of 28′ and length of 880′ available for storage. For this purpose 3,525 linear feet of trestle erected.

Crushed stone and sand delivered by trains made up of 12-yard dump cars; stone dumped on the inside, to minimize average haul to the mixers. Total storage capacity, about 45,000 and 50,000 c. y. of sand and stone, respectively, capable of supplying mixers for 17 working days of 8 hours each.

Necessary tracks for berm cranes required laying of two parallel 5′ gauge tracks 50′ apart in forebay.

Total of 11,000′ of narrow-gauge track constructed from forebay to lock chambers, necessitating construction of 1,400 linear feet of trestles for these tracks, which are laid on incline of 2½ per cent.

Total concrete laid, 166,869 c. y., of which 1,656 c. y. large stone placed in mass. Of this total, permanent plant laid 73,083 c. y. on basis of 8-hour day. Estimated concrete in locks, including approach and wing walls, 858,600 c. y., so there remain 691,732 c. y. to complete.

Steel collapsible forms used for main and lateral culverts, and wooden forms in built-up panels, 15′ long and 8′ high, are used for construction of walls. Panels are series of uprights, 14′ long, held together by walling strips and lagging. Latter placed on upper 6′, lower 8′ acting as cantilevers on concrete previously placed. Anchor bolts extend into masonry for 2′, and are removed as work progresses, leaving anchor nut embedded. Each panel used at least 12 times.

Filling back of west wall begun about June 1. Material obtained from Ancon quarry site.

West dam at Pedro Miguel consists of two mounds or toes of all classes of waste material, large percentage being rock, with intervening space filled with selected material, forming impervious core. Selected material clay, excavated from canal prism south of locks, and deposited from dump cars in layers about 6′ deep, each layer being thoroughly wetted down and compacted. Within the year 51,827 c. y. added to impervious portion and 41,964 c. y. to the toes.

Total of 99,703 c. y. removed below locks at Pedro Miguel. Bulk of this material placed in dam.

Miraflores: Excavation for upper locks of flight at Miraflores practically completed, work of preparing foundations, erecting concrete plant, and placing concrete begun. Total excavated, 234,731 c. y. by steam shovels, and 59,098 c. y. by hand, scrapers, and cranes. Of total excavated, 157,483 c. y. placed in toes of Miraflores west dam and 121,080 c. y. used as back fill.

Twenty-inch suction dredge worked in lower lock site until Dec. 20, 1909. Because of large number of bowlders and character of material, output small and performance of dredge unsatisfactory. As this dredge could be utilized to advantage in Atlantic division, it was transferred, arrangements being made for excavating remainder of material by hydraulic means. Dredge removed 141,759 c. y.

Preparing foundation of upper locks begun as soon as excavation completed sufficiently, and consisted of cleaning up loose material and excavating for lateral culverts and areas above miter sills. Work done by Thew steam shovel and by hand, total being 39,381 c. y. Excavation by steam shovels, classed as preparing foundations, 24,655 c. y.

Handling plant in these locks will consist of 4 berm cranes, 2 of which in operation in forebay at Pedro Miguel, and 4 chamber cranes, in use at Pedro Miguel. Tower and movable boom of one of berm cranes in place completely erected, and another on west side partly erected. Cantilever arms will be placed on these cranes when berm cranes at Pedro Miguel dismantled and transferred.

On east side of lock storage trestle 3,200′ long under construction, and 1,400 linear feet of tracks for berm crane laid and balasted. Two concrete mixers will be installed in storage trestle on east side and will supply concrete to berm crane for placing until mixers can be permanently installed on crane after work at Pedro Miguel permits. On west side berm-crane tracks and erection of trestles for storage in progress; fourth crane being assembled.

On June 1 concreting in upper lock begun on floor and lateral culverts, mixture being furnished by two ½-yard mixers, as it is desired to complete the floors before permanent plant is transferred from Pedro Miguel. Total concrete laid, 1,630 c. y. Estimated concrete in locks, including approach and wing walls, 1,327,300 c. y.

Reinforced concrete power house at Miraflores finished and in operation. Building 157′ 6″ long, 76′ 6″ wide, and eaves 39′ above generator-room floor, beneath which is basement. One end of building and portion of turbine-room floor of temporary construction, as depth and width of water turbines to be used have not yet been determined. Equipment similar to that at Gatun, described in last report. Furnishes power for operation of all cranes, for crusher plant at Ancon, and for sand-unloading cranes at Balboa.

West dam, from head of locks to Cocoli Hill, consisting of two mounds or toes made up of waster material obtained from lock excavation, mostly rock, and of hydraulic fill between them, continued. 157,483 c. y. placed in toes and 120,910 c. y. impervious material added by dredge.

Stone and sand: Broken stone for concrete furnished by quarry opened on west side of Ancon Hill, as described in last report. Installation of plant continued during early part of year, and practically complete Oct., 1909, when bad slide occurred on face of hill between crushers and storage bins, which delayed operations until material which had been moved could be excavated and some provision made to guard against future slides. Slide necessitated removal of 40,960 c. y. building large amount of rock-fill cribwork, and replacing conveyor connecting crusher and bins. In opening up quarry, 2,384 c. y. removed in preparing necessary grade, and 194,112 c. y. of stripping. Plant finally installed and operations begun Feb. 10, 1910, and 175,174 c. y. crushed stone secured. Quarry worked 8 hours per day, and during June furnished 32,232 c. y., or 155 c. y. per hour in service and 265 c. y. per actual working time. As large amount of screening required for road surfacing in connection with municipal improvements, small jaw crusher installed, fed directly from storage-bin pocket, which reduces size to ½″ or less; produced from 30 to 40 c. y. of finishing material per day.

Prior to operation of Ancon quarry, stone for concrete obtained from Rio Grande quarry, which furnished broken stone for ballast and highway construction. This quarry operated until Feb. 10 and supplied 58,928 c. y. In addition, 3,750 c. y. obtained from Atlantic division.

Sand for concrete obtained from bay formed by Point Chame, about 20 miles up coast from Balboa. Sand secured by French self-propelling ladder dredge and loaded into barges of 500 c. y. capacity, which are towed to Balboa, where it is removed from barges to storage bins by means of rapid unloading cranes. Dump cars loaded from bins by gravity and sand transferred to storage trestles at lock sites.

Under contract with Cleveland Crane & Engineering Co., 3 unloading cranes furnished, each having single cantilever 33′ long projecting beyond face of dock, operated electrically. Delay, due to defects in machines. Structural weaknesses developed, which required modification. Brakes originally furnished not satisfactory, and air-controlled brakes substituted.

229,250 c. y. sand secured during year, of which 101,748 c. y. sent to Atlantic division for use in concreting.

Hydraulic machinery: Material to be removed in 2-mile stretch of channel below Miraflores Locks amounts to 9,650,000 c. y., of which over 1,500,000 c. y. rock. As time is an important element and it was impossible to assemble sufficiently large plant to complete this section within limit fixed, hydraulic excavating plant selected as being most expeditious method of handling loam overlying the rock, and cheapest.

Plant as designed contemplates washing of material overlying rock to sumps by water jet under high pressure, and dredging pumps elevating and conveying material from sumps through flumes. Consists of central pumping station, pipe lines, hydraulic monitors, and dredging pumps. Central station located on west bank of canal, and in center of area to be excavated. There are mounted 4 Worthington horizontal, direct-acting, triple-expansion pumping engines with 24″ stroke, 24½″ water cylinders, and 19, 30, and 50″ steam cylinders. Each pump provided with surface condenser and direct acting single cylinder 12 by 20 by 24″ vacuum pump. Pumps discharge into common delivery pipe equipped with necessary checking gate valves. Steam supplied by 4 Babcock & Wilcox standard water-tube boilers arranged in batteries of two. Oil will be used for fuel, for which purpose 2 steel tanks of 2,000-barrel capacity each erected on hill at rear of station to feed oil burners by gravity. Supply pipe from pumping station 3,600′ long, of 2,000′ of 40″ and 800′ of 32″ lock-bar pipe, and 800′ of 24″ spiral riveted pipe. Main is provided with valves and tees suitably located for connecting branch lines leading to monitors. Branch lines 16″ spiral riveted pipe laid in groups of 3, so that 2 giants may be continued at work while third is being changed. Monitors are fitted with special deflecting nozzels. Dredging pumps, 3, are 18″ single suction centrifugal pumps, direct connected to 655-horsepower induction motor. Pumps, with motors, switchboard, and priming pump, all mounted on reinforced concrete barges specially designed by division engineer and constructed for the purpose.

Rio Grande River, which originally occupied portion of area to be excavated, diverted and dike constructed across south end to prevent access of tidewater to area. After removal of loam overlying rock by hydraulic process, rock will be excavated by steam shovel in dry.

South of area to be excavated by hydraulic means, necessary depth and width of channel will be secured by ordinary dredging operations. During year there were employed at this work 20″ seagoing suction dredge "Culebra," one 5-yard dipper dredge "Cardenas," and four French ladder dredges. Total output of dredges, 6,914,384 c. y., of which 57,161 c. y. classified as plant. Bids invited for delivery of ladder dredge having capacity of 1,200 c. y. per hour in sand and mud, for use in division and subsequently for maintenance work through canal.

Three methods employed in breaking up rock that it may be handled by dredges; rock lies in separate shoals of comparatively small area and volume. First method, by drilling and mining, in which case well drills operate through overlying earth to depth below required grade; holes are sprung, charged, and fired. By this means 274,339 c. y. rock broken up, of which 19,392 c. y. removed by dredges.

Second method, by subaqueous blasting, for which purpose drill barge constructed, consisting of steel hull 112′ long by 36′ 8″ wide provided with timber spuds—one at each corner of the barge. Three drill frames 38′ high located along one of gunnels, arranged to move lengthwise of barge on rails. Each frame carries slide to which is attached 5¼″ rock drill, and each slide operated by hydraulic ram and may be moved vertically through 10′. Drills operated over distance of 85′ from one position of barge, and holes spaced 5′ apart on 6′ centers located by ranges on shore. Barge began Mar., 1910, and blasted over area of 49,600 sq. feet.

Third method, by rock breaking, and Lobnitz rock breaker placed in commission Aug., 1909. It consists of a ram or cutter of steel fitted with hardened steel conical point which is alternately hoisted and dropped. Device mounted on steel hull 100 by 28 by 8′. Tidal range requires three sizes of rams, 30, 40, and 56′, weighing approximately 15, 16, and 19½ tons. General practice has been to attack surface of rock shoal which has been exposed by dredging with rock breaker at intervals of 4′ each way, points of attack being located by ranges on shore and permanent marks on bay. Average limit of penetration has been 3.12′. After entire area of shoal is gone over, rock breaker is removed and broken rock dredged. Area covered, 266,230 sq. feet, from which 25,515 c. y. dredged.

Balboa shops and shipways operated in construction of some new pieces of plant, including drill barge, erection of dump scows, construction of floating repair shop and crane boat. In addition, dredges, tugs, and barges were kept in good condition.

Municipal and sanitary work: In addition to municipal improvements carried on in Panama under separate appropriation by Congress, principal municipal work was erection of Cocoli pumping and filtration station installed to augment water supply for domestic and construction purposes furnished by Rio Grande Reservoir, consumption from which had increased so as to materially reduce pressure and supply at south end. Necessary pumps, treating and settling tanks, and filters erected at total cost of $34,324.39.

Reinforced concrete reservoirs of 10,000 and 100,000 gallons capacity constructed for Palo Seco Leper Asylum and Culebra Island quarantine station, respectively.

About 9,000 linear feet road connecting Corozal with Pedro Miguel completed, and portion of road connecting Corozal and Camp Diablo added. Extensive repairs made to Balboa and Sabanas roads.

Sanitary work consisted in cleaning 573,942 linear feet earth drains; construction of new earth drains requiring removal of 2,661 c. y.; filling swamps and holes at various points necessitating handling of 689 c. y., and construction of 9,700 linear feet of cement drains, and 3,838 linear feet of tile drains. **P-10,** 21–29.

1911. Pedro Miguel: Excavation of lock chamber, including slides, completed by removal of 16,423 c. y. In addition, 76,847 c. y. handled in preparing foundations. Greater portion removed with picks and shovels, loading into skips handled by locomotive cranes or derricks; steam shovels, however, used wherever practicable.

Construction plant in its entirety began operations July 15, 1910, and continued as a whole until Jan. 31, 1911, when dismantling plant was begun preparatory to moving it to Miraflores, under contract made for taking down cranes and reerecting them at Miraflores. Total concrete laid during year at Pedro Miguel, 498,187 c. y. Of this, 376,657 c. y. laid by construction plant and remainder, 121,530 c. y., supplied by three 2 c.-y. auxiliary mixers and by two ½-yard portable mixers. One of these large mixers located at south end of east wall and other two in forebay; one at south end of east storage trestle and other at south end of west trestle; those in forebay subsequently combined at south end of west trestle to make way for drainage of central division through middle wall culvert. Total concrete laid in Pedro Miguel Locks at close of year, 665,056 c. y., and, as estimated amount remaining July 1, 1911, was 172,345 c. y., lock 79.42 per cent completed.

Concrete supplied by construction plant mixed on berm cranes and transported by narrow-gauge railroad to chamber cranes which placed it in forms. Chamber cranes laid 401,725 c. y. concrete and 1,430 c. y. large rock during year.

Back filling behind side walls continued intermittently; total placed, 273,709 c. y., including 1,434 c. y. in center wall. Filling completed at north end of west wall to provide yard required by gate contractors.

West dam at Pedro Miguel can not be completed until drainage of central division diverted from site; will be done as soon as concreting in forebay of east lock completed, when water will pass through middle culvert. For this reason, no filling added to dam in past year. Trestle driven in continuation of west toe toward north; operations will be resumed during next dry season.

Miraflores: Excavation by steam shovels in upper lock completed except that removed in preparing foundations, aggregating 137,752 c. y.

Construction plant, two berm cranes partly erected at Miraflores consisting of towers and movable booms; one of east side completed Sept. 2 and placed concrete supplied by auxiliary mixers until erection of cantilever arm taken from berm crane used in forebay of Pedro Miguel began Feb. 15, 1911, when mixers placed in position. This machine finally completed and began operations Mar. 22, 1911. Second one assembled on west side of lock site; fixed cantilever arm in position, wiring completed, and put in commission Apr. 7, 1911. Third under erection on west side, and fourth being dismantled at Pedro Miguel. Before chamber cranes transferred to Miraflores, manner of using cranes changed; two to be reerected in east lock of upper pair with longer arms extending over center wall, and concrete to be supplied by portion of narrow-gauge equipment moved from Pedro Miguel from two auxiliary mixers erected in east wall. By this, two additional mixers added to plant, and chamber cranes can handle concrete to both sides of center wall. Moving of first berm crane begun Apr. 20, 1911, and second May 9; former had been assembled ready for wiring at close of year, latter in course of erection.

Prior to transfer of plant concrete laid by means of auxiliary plant consisting of two 2-yard mixers and four ½-yard mixers. Former installed in east storage trestle until removed to position on east wall for supplying concrete to chamber cranes. ½-yard mixers were portable and used for placing concrete in floors, lateral culverts, miter walls, and foundations for main walls. Total concrete placed in Miraflores Locks during year, 272,933 c. y. The partly completed construction plant placed 67,678 c. y., and remaining 205,255 c. y. supplied by auxiliary plant. Total masonry (concrete and large rock) laid by this division in locks on Pacific side, 771,120 c. y.

Storage trestles on both sides of locks completed and 156,571 c. y. crushed stone and 164,980 c. y. sand placed in storage. Various types of forms used, the same as described for Pedro Miguel in last report. Some transferred from Pedro Miguel to Miraflores after service at former place ceased.

East wall of upper lock partly back filled, 53,521 c. y. of material placed. Total concrete to complete Miraflores Locks, 1,424,563 c. y., so that locks at close of year 19.27 per cent completed.

Hydraulic excavating plant began operations in lower lock of Miraflores during latter part of Sept., 1910, and continued until Feb., 1911, by which time practically all overlying material had been removed; steam shovels then resorted to for removing rock. Hydraulic plant removed 332,703 c. y., greater part of which pumped into Miraflores Dam. At close of year steam shovels had excavated 247,700 c. y., material being used in Miraflores Dam and back fill for locks at Pedro Miguel.

Stone and sand: Broken stone for concrete furnished by quarry on west side of Ancon Hill, operated throughout year, with exception of 6 days lost by breakdowns and to replace main shaft on No. 16 crusher. Formation of rock is seamy, and seams filled with clay. To exclude this from product, screen added. Total produced, 855,824 c. y. Quarry operated on 9-hour day basis, except from Dec. 1 to Apr. 4, when 12-hour day in force. Of total crushed, 808,767 c. y. for locks; 35,382 c. y. for work in division other than locks, of which 16,505 c. y. for municipal work and 11,675 c. y. supplied to other divisions and departments. Quarry also furnished 76,411 c. y. large rock for back filling lock walls and other purposes.

Sand obtained from bay formed behind Chame Point, 20 miles west from Balboa. Dredged by ladder dredge into barges of 500 c. y. capacity and towed to Balboa, where transferred by rapid unloading cranes to bins. Total produced, 494,841 c. y. Of this, 465,426 c. y. used by Pacific division, 19,814 c. y. delivered to Atlantic division, and 9,601 c. y. sold to other departments. Sand unloaded from barges to bins by 3 electric cranes, 2 being operated 8 hours per day and 1 in reserve; 494,841 c. y. unloaded during year.

Hydraulic excavating plant began work in Sept., 1910, and deposited 444,145 c. y. of impervious material from prism to form hydraulic fill of west dam at Miraflores. In addition, 295,598 c. y. dry fill, obtained from excavation of locks, added to dam. On May

24, 1911, temporary spillway used for draining water from hydraulic fill gave way, through undercutting of outer toe, and about 96,000 c. y. escaped. Large portion of material moved around into Miraflores Lock pit and seriously interfered with prosecution of work. Dam 83 per cent completed.

Channel between locks and the Pacific Ocean: During last 5 months of fiscal year, 197,880 c. y. excavated in dry by steam shovels between Pedro Miguel and Miraflores Locks. Material used as back fill for Pedro Miguel Locks.

In area between Miraflores Locks and Pacific Ocean, excavation done by hydraulic excavating plant and by dredges. After completing work in lower lock chambers Feb., 1911, dredging units of hydraulic plant moved into sea-level section of canal, where they have since been operated. Numerous large bowlders and sunken logs encountered in process of sinking barges on which dredging pumps installed, and existence of rock requiring blasting at higher level than borings indicated prevented barges from settling to grades desired, and in some instances injured bottoms. For this reason barges abandoned and dredging pumps placed at intervals along axis of channel with their suctions in sumps extending slightly below final grade. Two pumps installed in this manner and third was still operated from barge. Amount removed from channel by this process outside of lock chamber, 197,677 c. y. Cost greater than anticipated, but since the dredging pumps can handle rock after it is blasted, which was not contemplated, resulting cost is less than combined cost of dredging equivalent amounts of earth and rock. Of amount so removed, 111,421 c. y. placed in dam at Miraflores and 86,253 c. y. used in reclaiming swamps east of canal channel.

Dredges operating in channel during year were 20″ seagoing suction dredge "Culebra," one 5-yard dipper dredge, and 3 French ladder dredges. Suction dredge operated over 7.5 miles of canal, measured from sea end, and others between point reached by "Culebra" and area inclosed for operation of hydraulic plant. They removed from channel 5,549,642 c. y. At close of year there remained total of 4,693,211 c. y. to be removed from channel south of Miraflores, including estimate for siltage.

Below point 7 miles from Pacific entrance to canal rock in prism lies in separate shoals of small area and volume, which are removed by subaqueous methods, heretofore described. Rock breaker "Vulcan" operated by two 10-hour shifts until Mar., 1911, after which one shift only used, as shoal had been removed to depth that made it impossible to work economically greater length of time, due to range of tides. Area covered by rock breaker aggregated 648,033 sq. feet, and material removed after breaking 49,266 c. y. Drill barge operated with two 10-hour shifts per day, and drilled and blasted area of 247,560 sq. feet, from which dredges removed 1,300 c. y.; this removed in May; should not be taken as indication of capacity of drill barge, as all rock broken by its operations during year not taken out on account of lack of available dredges, above-mentioned amount having been removed to determine whether or not sufficient amount of explosives used to properly shatter rock. Work continued until Apr. 4, 1911, with well drills operating through overlying earth by means of pipe casing. Estimated rock broken up by this method, 251,812 c. y.; 251,819 c. y. dredged.

Miscellaneous dredging consisted in excavating channel to lumber dock under construction, 705,465 c. y.; deepening berths in front of sand dock, 17,200 c. y.; Panama R. R. Co.'s commercial and coaling docks, 15,633 c. y.; shipways, 19,400 c. y.; and at hydraulic pumping plant, 18,000 c. y.

All necessary running repairs made to plant and floating equipment by Balboa shops and shipways. Equipment in addition to dredges already enumerated consists of 4 tugs, 7 scows, and 12 barges.

Municipal and sanitary works: In addition to municipal improvements carried on in Panama under separate appropriation by Congress, plant described in last report as installed at Cocoli Lake increased by installation of 8″ motor-driven centrifugal pump to lift water from lake to mixing tanks, which enables use of both 10″ pumps to force filtered water through mains. This addition made necessary because of demands for increased pressure in city of Panama. To permit of excavation of drainage channel from central division to Pedro Miguel Locks and to admit raising Balboa dumps, water mains moved.

Reinforced concrete reservoir at Palo Seco Leper Asylum completed July, 1910, and distributing system constructed. Aside from completing sewer system at Palo Seco, work performed during year consisted in making repairs, extensions, and house connections.

Of main highway practically parallel to canal and extending from Panama to Gorgona 3.14 miles constructed by Pacific division between Pedro Miguel and Corozal.

Sanitary work consisted in cleaning 511,010 linear feet of new earth drains, requiring removal of 3,257 c. y.; filling swamps and holes at various points, necessitating handling of 1,063 c. y.; construction of 6,136 linear feet cement drains; and laying 2,509 linear feet tile drains. **P-11**, 21-27.

1912. Excavation necessary to prepare for work on terminals, including coaling station, dry dock, and machine shops, placed under this division.

Excavation for Pedro Miguel Locks extended to include 95,156 c. y. removed during last year from French dump east of site, making total excavation done by this division for Pedro Miguel Lock 1,130,236 c. y., exclusive of material removed preparing foundations. In preparing lock foundations, which consisted of removing material below floor level to secure footings for walls, foundations for lateral culverts, sills, and sumps, 38,826 c. y. handled. Large portion removed with picks and shovels and loaded into skips handled by locomotive cranes or derricks into cars. Steam shovels employed wherever practicable.

At beginning of fiscal year construction plant moved to Miraflores, with exception of two chamber cranes. Dismantling of these began Dec. 12 and Feb. 7, respectively. Total concrete laid during year at Pedro Miguel, 182,870 c. y., mixed entirely by auxiliary plant, which consisted of one 2-yard mixer located at south end of east wall until Sept. 25, two 2-yard mixers installed at south end of west storage trestle in forebay, one of which moved on Mar. 15, and an average of 3.16 ½-yard mixers, moved about as considered most advantageous. Prior to dismantling, chamber cranes handled 28,450 c. y. of concrete supplied by auxiliary plant and were also engaged in setting ironwork and filling the center wall. Remaining 154,420 c. y. handled either by locomotive cranes and derricks or poured into forms from ½-yard mixers. Yardage for year, 134,193 c. y. plain concrete and 48,677 c. y. reinforced concrete. Revised estimates July 1, 1912, showed increase of 61,761 c. y. in total concrete previously estimated for these locks. Amount placed to June 30, 1912, 847,926 c. y. and estimated amount remaining 51,150 c. y.

Back filling behind side walls continued and total of 371,212 c. y. placed, of which 186,518 c. y. back of east wall, 162,757 c. y. back of west wall, and 21,937 c. y. in center wall.

Drainage from central division turned through culvert in center wall at Pedro Miguel Aug. 15, which permitted resumption of building west dam, and 321,589 c. y. added. Dam 87 per cent completed. Excavation for concrete core wall, to connect dam with wing wall of lock, begun and 95 per cent completed; material removed, 3,937 c. y.

At Miraflores excavation of lock pit continued; resulted in removal of 624,747 c. y., exclusive of that for preparing foundations. Of amount excavated, 120,351 c. y. earth and 504,396 c. y. rock. Of this, 364,767 c. y. used for back filling and 259,980 c. y. placed in toes of west dam. Surface of rock on which Miraflores Locks founded dips rapidly at north end of site. Walls originally located with their northern extremities on rock which was only few feet above desired grade. After excavation for locks had been begun, changes in design necessitated extending walls 98′ farther north, thereby not only increasing amount and depth of excavation required to secure suitable foundations, but adding materially to difficulties and cost, in that additional work had to be done in confined space below surface-water level; necessary to remove number of construction tracks located according to original plan. In this work and preparing lower lock foundations 165,145 c. y. removed, of which 26,832 c. y. earth and remainder rock.

On June 30, 1911, there were 2 berm cranes in operation at Miraflores, and the other 2 put in commission July 25 and Oct. 28, respectively. They handled concrete for side walls, forms, and irons, and worked on basis of 8-hour day, except from Dec. 21 to May 11, and from May 15 to June 8, when 2 cranes operated on basis of 12-hour day. The 8 mixers connected with them produced 409,651 c. y. concrete.

Four chamber cranes assembled and began placing concrete, handling forms, and steel July 13, Aug. 3, Feb. 15, and Mar. 26, respectively. Cranes handled 234,520 c. y. concrete and 7,342 c. y. filling for center wall. Operated on basis of 8-hour day, with some exceptions.

Two auxiliary 2-yard mixers installed in east wall of upper locks supplied concrete until yune 15, 1912, and from May 8 two 2-yard mixers installed on east wall of lower locks operated, making average of 2.09 mixers of this size for year; produced 253,450 c. y. concrete.

In addition to regular plant, average of 4.24 ½-yard portable mixers used, mainly constructing walls of forebay and upper reinforced-concrete approach pier.

Total concrete placed in Miraflores Locks, 751,540 c. y., made up of 729,096 c. y. plain and 22,444 c. y. reinforced concrete. Construction and auxiliary plants placed 401,079 c. y. and 350,461 c. y., respectively. Total masonry laid in locks on Pacific side, 934,410 c. y. and 174 c. y. in wing walls.

Total concrete laid in Pacific division locks to July 1, 1912, aggregated1,874 ,029 c. y. There remained to complete locks 51,150 c. y. at Pedro Miguel, as already noted, and 386,729 c. y. at Miraflores; in addition, there will be required to complete cut-off walls at Pedro Miguel 3,000 c. y. and dam at Miraflores 75,000 c. y.

Back filling lock walls continued with material from locks and prism below locks, and 450,686 c. y. placed, of which 315,487 c. y. placed back of east wall, 127,287 c. y. back of west wall, and 7,912 c. y. in center wall.

Crushed stone for concrete in Pacific Locks obtained from Ancon quarry which, with crusher plant, operated throughout year. For most part, operation was on basis of 9-hour day, but for few months was necessary to put on night shift for week or two at a time. Total produced by plant, 839,279 c. y. Of total crushed, 782,818 c y. placed in stor-

age piles for use at locks, 31,467 c. y. used in other work under charge of division, 21,642 c. y. sold to other departments and divisions, and 3,352 c. y. used in municipal work.

Sand for lock masonry and other concrete construction obtained from Chame Bay, located about 20 miles west of Balboa. Secured by dredging, thence loaded into barges, towed to Balboa, and transferred to bins by rapid unloading cranes. Of 3 electric cranes 2 operated 8 hours per day and 1 held in reserve. During year 564,837 c. y. unloaded. From bins it is loaded by gravity into cars and transported to storage piles at lock sites or to such other points as may be desired. Total produced during year, 564,837 c. y. Of this, 509,587 c. y. placed in storage piles for use in concrete, 34,394 c. y. delivered to Atlantic division, and 20,856 c. y. delivered to other divisions.

Hydraulic fill in west dam at Miraflores completed Dec. 4, 1911, and contains 625,048 c. y., of which 78,316 c. y. pumped into dam during year. Dry filling continued; 425,125 c. y. placed. Dam 87 per cent. completed; remaining work consists in connecting north end of "present" work and lock wall over space occupied by west storage trestle and train tracks.

Excavation of channel by steam shovels between Pedro Miguel and Miraflores and south of latter continued; 864,475 c. y. removed during year, of which 411,987 c. y. earth and remainder rock.

Hydraulic excavation plant in operation throughout year in sea-level section of canal south of Miraflores and excavated 900,596 c. y. Of this, 78,316 c. y. dumped into west dam at Miraflores and 822,280 c. y. deposited in swamps east of prism. Material deposited on adjacent swamps reclaimed 76 acres of tidal swamp land east of prism.

Dredges operating in canal below Miraflores were 20″ seagoing suction dredge. "Culebra," 5-yard dipper dredge "Cardenas," 3 French ladder dredges, and, for a period of 3 months at close of year, new ladder dredge "Corozal." Operating in prism dredges worked between stations 2100 and 2236, or for 13,600′, lower end of which is 1,855′ north of French dock. During year dredges removed 4,683,902 c. y. Of this, 3,884,287 c. y. removed from channel, including about 1,044,203 c. y. in maintaining channel, and 799,615 c. y. outside of prism in vicinity of terminals at Balboa, in maintaining berth at sand dock, and in excavating channel to Flamenco Island. Of latter, 370,607 c. y. removed from area of basin in connection with terminals on Pacific side. Ladder dredges could not dredge economically on account of depth of water at high tide, and rather than tie them up they worked in this area pending action by Congress on recommendations relative to terminals. There remained at close of fiscal year to complete excavation in channel 4,194,059 c. y., including 700,000 c. y. estimated allowance for silting.

South of station 2142 rock that must be removed in order to secure required depth lies in separate shoals of relatively small area and volume, and rock is broken up for dredging by drilling under water with drill scow and breaking below water with Lobnitz rock breaker. Three drills operated on drill barge, on two 10-hour shifts, and covered area of 236,082 sq. feet, through which 153,819 linear feet of holes drilled. Of amount broken up, 160,903 c. y. removed by dredging. By rock-breaker method area covered approximately 563,617 sq. feet and depth of penetration averaged 3.69′. Amount dredged from area thus broken aggregated 77,156 c. y.

Dredge "Corozal" is self-propelling center-ladder dredge designed to excavate mud or sand at rate of 1,200 c. y. per hour from depth of 50′ and to discharge spoil directly into hoppers of 1,020 c. y. capacity or into barges alongside. Two sets of 39 buckets provided, one set with capacity of 54 cubic feet per bucket for use in soft material and other set with capacity of 34 cubic feet per bucket to be used when digging rock. Dredge delivered by contractors Balboa Mar. 27, 1912.

No equipment assembled or erected during year at Balboa shops and shipways. All necessary running repairs made to plant and floating equipment at these shops. Equipment, in addition to dredges already enumerated, consisted of 5 tugs, 6 clapets, 7 dump scows, and 6 sand and 4 service barges.

In addition to municipal improvements carried on in Panama under separate appropriation made by Congress, municipal improvements consisted in replacing 16″ main from Rio Grande Reservoir by 20″ main at cost of $158,562.87. 16″ pipe from reservoir to Pedro Miguel Locks left in position, where, together with 20″ main, connected to 24″ pipe embedded in emergency dam sills. Both mains again connected on east side of locks and double line extended to within 2,490′ of Ancon pumping supply. This done not only to insure supply and pressure at south end of system, but to avoid changing large number of temporary connections already made for construction work with 16″ line. Second 10″ line from Cocoli pumping station to main at Miraflores also added. Cocoli pumping and filtration plant, installed for pumping from Cocoli Reservoir to make up deficiency in Rio Grande supply, increased by addition of two pumps; 3-stage, motor-driven centrifugal, with capacity of 1,500 gallons per minute each against a head of 300′, and are direct-connected with 200-horsepower, 3-phase, 25-cycle motors.

Reinforced concrete dock constructed for Panama R. R. by Pacific division and described in last report completed, including back filling. Dredging in front of wharf, aggregating 1,005,983 c. y., not completed, but advanced sufficiently to permit docking vessels for 575′. 45 caissons sunk to rock, greatest depth found being 64.08′ below mean tide and least depth 52′ below mean tide. Total cost of dock, $351,741.39.

Borings made over area to be occupied by dry docks, coaling station, terminal docks, and machine shops, and, based on these, permanent locations selected.

Sanitary work consisted in cleaning 654,531 linear feet of earth drains; excavation of new earth drains, requiring removal of 3,274 c. y. earth; sweeping 627,009 linear feet of cement drains; filling swamps and holes at various points, necessitating handling of 975 c. y. material; laying 270 linear feet of tile drains; constructing 5,164 linear feet of cement drains; and clearing 112¾ acres of vegetation. **P-12,** 31–38.

1914. S. B. Williamson, division engineer, concluding that the work of his division had advanced to such a state that the I. C. C., not warranted in continuing his position, tendered his resignation, effective Dec. 11, 1912; reluctantly accepted. This action necessitated a reorganization of work on Pacific side. That relating to terminals, which during the previous year had been assigned to Pacific division, transferred to second division, which had charge of preparing designs for shops, dry docks, and coaling stations. Locks, dams, spillway, dry excavation between and below locks, the quarry, and municipal engineering work organized into fifth division of O. C. E. and placed in charge of H. O. Cole as resident engineer. Dredging and operations for procurement of sand constituted sixth division of O. C. E., under W. G. Comber as resident engineer. **P-13,** 1.

Pacific Side of Canal.

Conditions on, map, **P-13,** pl. 102.

Pacific Slope.

Change of position of locks and dams, **P-08,** 63.

New project, **P-08,** 64.

Paints, Economical.

Formula, **P-09,** 180.

Panama Canal. (See No. 248, p. 2367 of this Index.)

Division of work, natural, **P-07,** 17, 21.

U. S. representative at transfer of Panama Canal properties: Lt. Mark Brooke, Corps of Engineers, U. S. Army, **P-04,** 36.

Transfer: Republic of Panama desired appropriate ceremonies at transfer; action taken to delimit the probable boundaries of the zone. Officials told to proceed with their duties according to laws in force. U. S. officials willing to have ceremonies, but none of any special character conducted. **P-04,** 78.

Panama Canal Act. (See Acts; Laws.)

Panama Canal Act. Approved Aug. 24, 1912.

Act providing for the opening, maintenance, protection, and operation of The Panama Canal, and the sanitation and government of the Canal Zone. **P-12,** 599–605

Zone to extend 5 miles on each side of center line of canal, from 3 mile limit in Caribbean to 3-mile limit in Pacific, excluding cities of Colon and Panama and their adjacent harbors within the zone, but including certain islands, and any necessary lands and waters necessary from time to time. Sec. 1.

Existing laws, orders, regulations, etc., ratified. Sec. 2.

Claims and titles of occupants of land wanted for U. S. purposes to be extinguished. Sec. 3.

Providing for discontinuance of I. C. C., and for government, etc., through a governor, and such other persons as the President may deem competent. Sec. 4.

Governor to be appointed for 4 years by the President and Senate and until his successor shall be appointed and qualified. Salary, $10,000 a year. Sec. 4.

The Panama Canal, upon completion, to be officially and formally opened. Sec. 4.

Commission of Arts to report to the President recommendation regarding artistic character of the structures of the canal, the report to be transmitted to Congress. Sec. 4.

The President authorized to prescribe or change tolls. Changes to be after 6 months' notice. Sec. 5.

No tolls to be levied upon vessels engaged in the coastwise trade of the U. S. Sec. 5.

Tolls may be based upon gross or net registered tonnage, displacement tonnage, or otherwise; there may be one form of tonnage for warships and another for other ships. Sec. 5.

When based upon net registered tonnage tolls shall not exceed $1.25 per ton. Modifications relating to U. S. ships, treaty with Panama, etc. Sec. 5.

Toll for each passenger shall not be more than $1.50. Sec. 5.

The President authorized to amend regulations governing operation of the canal, etc. Sec. 5

Regulations to provide for prompt adjustment of claims, etc., relating to passage of commerce. Sec. 5.

The President to provide a method for the determination and adjustment of all personal-injury claims of employees, etc. Sec. 5.

Wireless installations authorized. Sec. 6.

The President authorized to establish, maintain, and operate dry docks, repair shops, yards, docks, wharves, warehouses, etc., for U. S. craft and, incidentally, passing craft at reasonable prices. Money thus obtained to be expended or reinvested, but monthly reports of receipts and expenditures required. Annual report to be made to Congress. Sec. 6.

Civil government of the zone shall be under official control and jurisdiction of the Governor of the Panama Canal. Sec. 7

The President to determine what towns shall exist in the zone. Provision for courts, etc. Magistrates, etc., to be appointed by the governor for 4 years, etc. Rules governing courts, etc., to be established by order of the Presi-

- dent. Notaries to be appointed by the governor. Sec. 7.
- One district court with two divisions to be established in the zone. Rules of practice to be prescribed or amended by the President. Scope of the authority of the court. There shall be a district attorney and a marshal. The judge, attorney, and marshall to be appointed by the President, in conjunction with the Senate, for 4 years. Sec. 8.
- New courts shall take over and carry forward pending proceedings at time of formation of the new court with its divisions. Sec. 9.
- All existing laws in the zone governing practice and procedure shall be applicable and adapted to new courts. Sec. 9.
- The Circuit Court of Appeals of the Fifth Circuit of the U. S. to have jurisdiction, etc., over zone court, final appeal or review to be to the Supreme Court of the U. S. Sec. 9.
- The governor to make rules and regulations governing trespass, injury of works, etc. Penalties. Sec. 10.
- From July 1, 1914, unlawful for railroad company to conduct, etc., directly or indirectly, common carriage by water through the Panama Canal or elsewhere, etc. Penalty. Sec. 11.
- Jurisdiction conferred on Interstate Commerce Commission to determine questions of fact concerning alleged competition of railways through water carriage. Order of I. C. C. to be final. Sec. 11.
- If I. C. C. of opinion that existing water service controlled by railways other than through the Panama Canal beneficial to the public, extension of it may be arranged. Sec. 11.
- No vessel engaged in coastwise or foreign trade of the U. S. shall be permitted to use the Panama Canal, if owned, etc., by monopolies, etc.; provision for determining fact. Sec. 11.
- The I. C. C. to have jurisdiction over interstate commerce in certain particulars relating to connection with the Panama Canal. Sec. 11.
- Extradition for crime to be governed subject to treaties; otherwise the zone shall be considered and treated as an organized territory of the U. S. Sec. 12.
- In time of war or imminent war an officer of the Army designated by the President shall assume and have exclusive authority and jurisdiction over the Panama Canal and zone, and the Governor of the Panama Canal shall be subject to his order, etc. Sec. 13.
- The act to be known as the Panama Canal act. Sec. 14. **P-12,** 599–605.
- Repeal, June 15, 1914, of provision that no tolls shall be levied upon vessels engaged in the coastwise trade of the United States, **P-14,** 557.
- Third sentence of third paragraph of the Panama Canal act amended June 15, 1914, to read: "When based upon net registered tonnage for ships of commerce the tolls shall not exceed $1.25 per net registered ton, nor be less than 75 cents per net registered ton" subject to convention between U. S. and Panama of Nov. 18, 1903: *Provided*, the passage of "this act" not to be construed, etc., as waiver, etc., of any right U. S. may have under treaty with Great Britain of Feb. 21, 1902, or with Panama, of Feb. 26, 1904, to discriminate in favor of its vessels by exempting the vessels of the United States or its citizens from the payment of tolls for passage through said canal, or as in any way waiving, impairing, or affecting any right of the United States under said treaties, or otherwise, with respect to the sovereignty over or the ownership, control, and management of said canal and the regulation of the conditions or charges of traffic through the same. **P-14,** 557, 558.

Panama Canal Co. (See Nos. 14, 15, p. 2361 of this Index.)

Panama, City of. (See Nos. 39, 155, pp. 2362, 2364 of this Index.)

Panama R. R. (See Nos. 44, 73, 140, 189, 234, pp. 2362, 2363, 2365, 2366 of this Index.)
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Panama Railroad. Operation.
1904. Suggestions of Sec. of War Taft looking to complete control of the railroad by Isthmian Canal Commission No. 2. Directors of the road ordered to end agreement with Pacific Mail S. S. Co. for issuance of exclusive through bills of lading. Agrees with Gen. Davis that it might be better for the railroad to get out of the steamship business by leasing or selling its three steamers. Best course for Isthmian Canal Commission No. 2 to pursue to limit commercial business as a common carrier to the railroad on the Isthmus, and to offer to all American lines at least reasonable rates, with through bills of lading, without discrimination in favor of any line. **P-04,** 13–16.
The French canal company sold to the U. S. 68,887 shares of stock in the Panama R. R. Total shares, 70,000; hence, U. S. acquired 98½ per cent. History of railroad. First concession acquired 1848; in 1849 New York incorporated the company by a special act; road continuously existed under that act, and one amendatory passed in 1855. Road completed in 1855. Road, instead of receiving subsidy for its construction, has had to pay Colombia $250,000 annually, and to transport free of charge the troops, chiefs, and officers, and their equipage, ammunition, armament, clothing, etc., and new settlers to the number of 2,000 annually. When turned over to the U. S. road consisted of 47.65 miles of single track, with 26.07 miles of sidings and yards. 24 locomotives, 11 switching engines, over 20 passenger cars, about 1,000 freight cars, etc. Equipment in poor condition. Three steamships owned by the company, with total tonnage of over 8,000; American built, on the Delaware. Description of property and right of way owned by the company. Table showing gross receipts, operating expenses, fixed charges, dividends, etc., 1895–1904. Bond issues. During the year Isthmian Canal Commission purchased 100 additional shares of the company, leaving but 1,013 shares outstanding in hands of private individuals. Offer made publicly to buy the remaining shares at par; considered liberal in view of the past returns on the shares. In view of the large amount of transportation which has been free under its concession, the railroad has had to charge high rates; steps taken to reduce this traffic. In 1903, 4,633 first-class paying passengers were carried and, also, 11,098 passengers and 6,601 troops carried free. New and additional steamers planned. Management of road vested in 13 directors; 7 resigned, and their places filled by members of the Isthmian Canal Commission. **P-04,** 57–65.

1905. Entire stock owned by the U. S. Bonds largely in hands of public. Essentially a part of the canal construction plant. Road neglected by French. New wharves begun, terminal yards, machine shops, etc. Complete rehabilitation under way. Personnel reorganized. Double-tracking at places, paid for by Isthmian Canal Commission No. 3. **P-05,** 18.
Before coming of the Americans no enterprise exhibited. Plant antiquated. Lack of equipment, terminal, and line facilities. Freight tied up for months on the road. 500 flat cars added; 200 of them in commission. Dock facilities increased. Terminal yards improved. Double-tracking in progress. Personnel improved. Methods for reducing cost of handling freight installed. 56-pound rail being replaced with 70-pound rail. Haulage congested through an unlooked-for quarantine placed on shipments by South American ports. Nature of traffic such that low cost of handling freight not in sight. Commissary opened by road for benefit of employees. **P-05,** 121.

1906. Great progress made in enlarging and improving the road; new organization completed; shipping at terminals promptly discharged; Nov. 6, 1906, new schedule of sailing cut off one day from the lay-over at each end of the route; no congestion of freight

since Dec., 1905; across-Isthmus freight rates, etc., settled with steamship lines; reconstruction of old tracks; double-tracking going on and almost finished; probability that sections of the road will require more than 2 tracks. **P-06,** 10.

1907. Surveys for new line, made necessary by canal line, begun latter part of July; completed Nov. Location practically determined in Mar., 1907. Involves excavation of 1,600,000 c. y., and placing of 12,000,000 c. y. in embankments. Work on new location vicinity of Gatun and Mindi begun in May. Diversion tracks opened, to fills for Culebra and Chagres stuff. 30 branches started at various places; trestle built at Gatun and at Pedro Miguel; culverts begun. 36,661 c. y. excavated. 92,180 c. y. hauled and placed in embankments, permitting laying of 6,852 linear feet permanent track. 4 steam shovels, 1 pile driver, and an aggregate of 1,100 laborers. **P-07,** 14, 15.

Rebuilding of old line completed; building of new double-track, save 4 miles from Gatun to Lion Hill, completed. Sidings, storage tracks, and block systems installed. 15 miles of track washed out between Mindi and Bas Obispo, during an unusual flood in Dec., 1906, in Chagres River. 90-pound rails being installed; 70-pound rails too light for traffic. Coal-handling plants, yards, etc., installed. Lay-over time of steamships lengthened by one day to former lay-over; only because of time needed to repair steamship machinery. Equipment increased; 100 Rogers ballast cars, 273 box cars, 10 stock cars, 12 caboose cars; 2 Rogers ballast-sand plows; 9 first-class coaches, 10 second-class coaches, and 4 baggage and mail coaches. **P-07,** 33.

1908. Relocation: Made necessary by overflow of the existing roadbed by water storage for lock canal. Atlantic terminal to Mindi (5 miles), and from Corozal to Panama and La Boca, the old line to be used. Between Mindi and Corozal road will be carried to the east, and at a general elevation of 95, or 100′ above the normal surface of the lake.

Progress of relocation: Connecting tracks made last year. Preparatory work continued; work shut down due to lack of funds. Portion on Gatun site moved.

Embankments: A number of valleys north of the Chagres require heavy revetments, material being obtained best from Culebra division. Bridge built across Chagres near Gamboa to make connection.

Tunnel work: Miraflores Tunnel continued; material treacherous; work advanced to permit laying of concrete for lining.

Culverts: Two constructed; one for flow of Pedro Miguel River and the other for the Caimitillo River.

Double-tracking and viaduct work: Isthmian Canal Commission paid for some advantageous work of these classes.

New lines: Changing locks from La Boca to Miraflores saved the construction of a new line from the Cardenas River to La Boca, as well as the erection of new wharves. **P-08,** 20, 21.

1909. New Panama R. R. between Gatun and San Pablo: 20 miles; final location not yet determined; decided to abandon originally selected crossing of the Gatun Valley, to gain unobstructed passage to the anchorage basin; surveys along the Bohio, Agua Salud, and Baldo Espino ridges developed shorter line of much less curvature.

Plans: Entire relocated line to be 46.2 miles long; maximum grade, 1.25 per cent Mindi to Gatun, and 0.45 per cent between Gatun and Panama; maximum curvature, 6°.

Value of road: Opinions differ as to value of road after completion of canal.

Construction: Fill south of Gatun station brought up to grade. Main work has been confined to construction along the ridge bordering the Gatun Valley, grading in the vicinity of Gatun River crossing, opening up and grading the line from the crossing to the connection at Caimito, and building the Miraflores Tunnel and grading in that vicinity. Trestle work and filling; branch tracks built to old line; culverts under construction.

Work prosecuted with a view of having the line advanced for its operation between Gatun and Bas Obispo when the lake level is raised sufficiently to permit the operation of dredges in the lake sections of the central division.

Construction work done by the Panama R. R. under an agreement with the Isthmian Canal Commission.

In charge: R. Budd, chief engineer of the Panama R. R., and Lt. F. Mears, First Cavalry, U. S. Army, as assistant. **P-09,** 18, 19.

1910. Construction of new line for Panama R. R. being done by Panama R. R. Co. under agreement with Isthmian Canal Commission. In charge of R. Budd, chief engineer of Panama R. R., until he resigned, Sept. 21, 1909, since which date Lt. F. Mears, First Cavalry, U. S. Army, has continued in charge.

At beginning of year work in progress upon entire stretch, Gatun to Gamboa, with exception of 8 miles through valley of Gatun River. As canal construction contemplated closing of west diversion and discharging Chagres River through spillway, elevation of which was placed 10′ above sea level, work on relocation had to be arranged to give continuous communication at such times as main line of Panama R. R. is flooded. Work therefore pushed to have through route available, and temporary line on 60′ level completed Apr. 23. Trestles driven over bottoms of Quebrancha, Brazos, Baja, and Gatun, and while outside center line, they are so arranged that these fills will form parts of completed embankments. Filling in of these trestles under way; no special difficulty met except across Baja bottom, where material overlying rock very soft and treacherous. In embankment across Gatun River arrangements will be made for bridge of three spans at 95′ level to allow for floods; one span will be converted into lift span for navigation of eastern arm of Gatun Lake. Temporary provision made for floods by use of two girders formerly spanning Chagres at Barbacoas.

Trestles along line from Caimito to Gamboa Bridge turned over to central division for filling and used as waste dumps for material from cut; this portion practically complete. When floods necessitate use of relocated line during construction, connection between Gamboa and "present" line of railroad will be at Matachin over construction track of central division laid on the barrier which separates cut from the Chagres.

Permanent culverts of reinforced concrete constructed to take care of various streams crossed by embankments.

In addition to 2,350,000 c. y. dumped by central division along new line, 2,500,000 c. y. excavated and disposed of in embankments, 17,000 c. y. concrete laid, 25,000 linear feet of temporary trestle constructed, and 15,000 linear feet of bridge piling driven..

Completed track for most part ballasted by gravel secured during dry season from gravel pit opened on the Chagres about 1 mile above Gamboa Bridge, and from Gorgona gravel pit operated by maintenance of way department of Panama R. R. In all, about 42,000 c. y. secured, 18,000 c. y. of which placed on line and balance stored.

Present plan contemplates use of 95′ berm on east side of Culebra Cut as location of new railroad, and will be finished by central division in connection with excavation.

During early part of year decided to push work on section from Paraiso to Corozal that "present" line of railroad might be turned over to Isthmian Canal Commission for moving spoil trains. Section 4 miles long; consists largely of embankments made from spoil from Culebra. Practically complete, and laid with new 90-pound steel rails. To secure better alignment for high line, part of operated line diverted. Two temporary stations built to replace those of old line abandoned at Pedro Miguel and at Miraflores. **P-10,** 30, 31.

1911. All grading from Gatun to Gamboa practically completed at beginning of fiscal year, except for 3 miles where line crosses valleys of Quebrancha, Brazos, Baja, and Gatun Rivers. Ground level of Quebrancha bottom at average elevation of 20′ above sea level, while soundings indicate rock is from 150′ to 180′ below this elevation and overlaid with soft, sandy clay, with harder stratum of clay and pure sand near surface. As height of embankment across bottom averages 71′, necessary to spread out base of fill so weight would not disturb upper stratum sufficiently to squeeze out softer material below. First fill carried to elevation 50 and out to 2:1 slope stakes. After this fill made, trestle to elevation 70 driven across it and filling from this level started. Small settlement occurred along trestle with corresponding upheaval beyond slope stakes and additional counterweight added on both sides well beyond stakes, after which raising of center line to permanent grade continued. By June 30, 653,505 c. y. placed.

Across Brazos bottom original elevation 30′ above mean tide, necessitating construction of embankment averaging 60′ in height. Filling across bottom has given no trouble and 1,112,036 c. y. placed.

Baja bottom has given trouble from time filling began. Elevation of natural ground 25′ and depth to rock 60′; overlying material softest kind of clay intermixed with decomposed wood and vegetation. As embankment settled additional weight put along toes and in this way fill gradually raised until at close of year it was about 10′ below grade. Average fill over valley, 67′, and at close of fiscal year 495,925 c. y. placed in fill.

Gatun River bottom at crossing of railroad line requires fill averaging 62′ in height. Permanent bridge to be located at this point and embankment at bridge to be raised to plus 97. Small settlement occurred on south end of Gatun River Valley, which rolled and pushed up natural ground for two or three hundred feet. This well filled over and counterweighted. Total material placed in this fill to close of fiscal year, 932,238 c. y. As but few main line cuts remained to be excavated at close of last fiscal year, greater part of material for fills across these valleys secured from borrow pits.

Reinforced concrete piers for permanent bridge across Gatun River built during dry season. Designed to carry three plate girders which now form north span of Barbacoas Bridge in operated line. Creosoted pile bridge driven to west of these piers, to be available for operation during dismantling of Barbacoas Bridge, and for erection of girders. To give access to upper Gatun Valley, one span of bridge will be of bascule type.

Under original plans for relocation of Panama R. R., operating track to be carried through Culebra Cut on berm at elevation 95. Because of slides along east side of Culebra Cut, and necessity of maintaining through communication when line is flooded, permanent location on berm line through Culebra Cut had to be abandoned, and high line around Gold Hill adopted; will be used until condition of banks through Culebra Cut permit return to original location. Surveys for location of high line begun July, 1910; construction commenced Jan. 1, 1911. Location necessitates 1¼ per cent grade and maximum curvature of 7°. Cuts and fills about balance at 1,250,000 c. y. Length of line, 9⅜ miles from Gamboa to Paraiso. New culverts will require placing of 9,000 c. y. concrete, and new fills will necessitate driving 2¼ miles of temporary trestle.

During year 696,742 c. y. excavation completed; 7,035 c. y. concrete placed; 11,446 linear feet trestle driven; 53,639 linear feet temporary track laid; and 257 acres of clearing done.

Construction of permanent telegraph and telephone line undertaken, and built of 56-pound steel rails for poles, with 4 cross arms, 10 pins to arm, making 40-wire line. On June 30 line Gatun to Gamboa Bridge 50 per cent completed.

On completed section, near Gatun and south of Monte Lirio, 6 miles of 90-pound steel rails laid, in large part on hardwood ties. Ballasting continued along permanent track, Chagres River gravel being used. Relocated line from Paraiso Junction to Corozal Junction formally turned over to Panama R. R. Co. Sept. 4, 1910.

To complete excavation of central division through Chagres section at Tavernilla and San Pablo during next dry season, necessary to interrupt operation of old line; to this end every effort being made to complete new line Gatun to Gamboa by Jan. 1, 1912. **P-11,** 31–33.

1912. At beginning of year construction work confined to stretch from Gatun to Gamboa—Gatun Valley section—and consisted in completing embankments across Quebrancha, Brazos, and Baja bottoms, under construction since 1910. Material reported as necessary at beginning of fiscal year for their completion, 850,000 c. y., exceeded and, though practically completed Jan. 1, 1912, two steam shovels at work during following month and a half furnishing material for riprapping slopes. Largest embankment on this section 4,800′ long, across Brazos bottom. Rock in this valley from 150 to 200′ below surface, which is of fairly good clay, 20 to 30′ thick, but between this and rock the material very soft. Embankment, 60.70′ high, given side slopes of 1 on 2 with hope that this would spread foundation sufficiently to enable layer of clay to support it without disturbing soft strata. Just before full height reached, however, pressure became too great and soft material moved out, upheaving natural ground beyond toes of slopes. When this occurred base was widened to secure slope of about 1 on 3 before any weight was added to upper level, after which embankment completed to grade. Trouble with settlements encountered in fills over Quebrancha and Baja bottoms, where it was necessary to spread base to secure slope of 1 on 4; these fills 72.70′ and 68.70′, respectively, above natural surface of ground. In the 3 miles covered by these bottoms, 4,736,072 c. y. placed, or an average of 1,578,690 c. y. per mile, all necessary to secure permanent roadbed above proposed lake level.

Laying remainder of permanent track undertaken Dec., 1911, and completed far as practicable by Feb. 15, 1912. Track of 90-pound open-hearth steel, 100 per cent splice bars, and either creosoted or hardwood crossties fitted with "Economy" tie-plates and screw spikes. Track ballasted with gravel obtained from deposits in Chagres River. This section formally turned over to Panama R. R. Co. Feb. 15, 1912, on which date operation of the road transferred from old to new line. Trains now operate east of canal as far as north end of Culebra Cut, where they switch back across canal on construction dike to old main line, following it north to Gorgona, thence south over old route to Panama. Operation over new roadbed attended with no difficulties, except small slides along slopes. Riprapping submerged embankments continued and weight of rock has sometimes caused sides of fill to slide.

Slides on east side of Culebra Cut and necessity of maintaining through communication caused construction of high line around Gold Hill and abandonment of original plan of carrying railroad on 95′ berm through Culebra Cut. Hoped that eventually high line might be abandoned in favor of 95′ berm, but this given up on account of excessive cost of rebuilding berm throughout cut. Gold Hill line joins Gamboa Bridge on north with Pedro Miguel on south, and is 9⅜ miles long. Summit is near La Pita divide at elevation 271′ above mean sea level, and Continental Divide is crossed opposite Culebra at elevation of 241′ above mean sea level. This section of road well under construction at beginning of fiscal year, and work progressed to completion in early part of 1912. Some difficulty encountered along Pedro Miguel River on account of slides. Laying of permanent track begun in May and line completed and formally turned over to Panama R. R. Co. May 25, 1912.

Construction of telephone and telegraph line continued and completed June 30, 1912. New frame station building and section house erected at town site of Monte Liro, on Gatun River, and reinforced concrete water station constructed at Frijoles. Dismantling old bridge at Barbacoas—3 girder spans—undertaken as soon as original Panama R. R. abandoned, Feb. 15, 1912. Bridge transferred to Monte Lirio, to be used for carrying relocated line over Gatun River. The two shore spans set in place at new site and center span to be converted into balanced lift span, so that steamers can have access to upper arm of Gatun Lake.

During year 3,209,021 c. y. grading completed and 123,463 lineal feet permanent track laid;

1,820.2 c. y. concrete were placed in bridge culverts. **P-12,** 45–47.

1913. Work during year consisted of riprapping slopes of embankments through Gatun Lake section, building lift span of bascule type in bridge spanning Gatun River at Monte Lirio, and installing automatic signals throughout line.

Material from Culebra Cut utilized during year in strengthening embankments near mileposts 20, 21, and 24, and also embankment in Brazos Valley. Total used, 257,831 c. y.

Bridge across Gatun River at Monte Lirio consists of 3 plate-girder spans formerly used on old line of railroad for crossing Chagres River at Barbacoas. Center span, a 103′ plate girder, converted into lift span by addition of lifting trusses, lifting mechanism, and counterweight; will provide channel 80′ wide in clear, with depth of 45′, thus giving ships access to large area of lake which lies east of railroad. Necessary materials purchased under contract for $24,390, and bridge erected by forces of Panama R. R. at a cost of $59,611.20, including combined operator's house, block office, and interlocking cabin.

Automatic signals installed Mindi to Corozal, with exception of about 4 miles between Caimito and Gamboa cabin, where main tracks are not on permanent grade and alignment. Signals placed between Pedro Miguel and Corozal removed when it became necessary to use new line for passage of dirt trains to enable cutting of old line for construction of Miraflores spillway. **P-13,** 48–49.

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- Including those laborers who work but transiently, 25,000 men under direction supervision of Isthmian Canal Commission and Panama R. R. Of the 17,000 continuous employees, 12,612 in department of construction and engineering, 1,129 in division of material and supplies, 2,291 in department of government and sanitation, 137 in the auditing and disbursing offices and 3,700 on gold rolls, all being virtually white Americans. **P-06,** 5.

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Hollow poles of cement, **P-13,** 10.

Police. (See Civil Administration; see No. 119, p. 2363 of this Index.)
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1905. Sept. 12, 1905; 3 officers, 176 men, and 6 clerks. Total arrests, 2,373, in a population of 25,000. Convictions, 1,573. No public gambling in the zone. Jails and police stations established. Site for a penitentiary selected. Cooperation of zone police and those of the Republic. Colored police officers admirable in dealing with West Indians, etc. Chief of police marshal of the supreme and circuit courts. Acts also as coroner. **P-05,** 71.
1906. Force had increased to 300 officers and 7 clerks by Sept. 30, 1906. Arrests, an average of about 355 a month in a population of about 22,137. Average getting lower. Violations of sanitary measures most frequent cause of arrest. Three jails completed, 4 under way; others authorized. Convicts used on road systems, etc. **P-06,** 43.

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Executive order establishing, on Isthmus, **P-12,** 609.

Postal Service. (See Civil Administration; see each annual report; see Nos. 55, 112, pp. 2362, 2363 of this Index.)
Extended. Panama stamps, bought at 40 per cent by U. S., used. Most mail franked, but sales of stamps $1,775.79, 1905, opposed to 655.54, 1904. **P-05,** 64.
Receipts increasing, with increase in personnel. Money-order system begun June 1, 1906. Mail being handled promptly; system becoming almost self-sustaining. 75 per cent mail franked. **P-06,** 32.

Post Office.
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Las Cascadas, **P-08,** 280, pl. 185.

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Power house, Miraflores, **P-09,** 97; **P-10,** 171, 196, pl. 47.
Terminal construction, **P-14,** 168.
Transmission or power line, operating locks, **P-12,** 93.

Power and Machinery, Division of Motive.
1907. Embraced the erection and preparation for service of machinery necessary in canal construction, and its maintenance in good repair; the installation and operation of air-compressor plants; work in connection with electrical installation; manufacture and repair work for other divisions.
Employees: 2,479 during year; expenditures, $6,360,496.56. 63 steam shovels, 284 locomotives, 2,706 dump cars, 18 unloaders, 13 bank spreaders, 33 unloading plows, 3 track shifters, and 7 pile drivers erected and made ready for service. Done mainly at old plants at Cristobal, Gorgona, Empire, and Paraiso. New plants at Empire and Paraiso begun. Some facilities provided at Pedro Miguel, Rio Grande, and Tabernilla. Engine houses built at various points, as well as auxiliary devices. Air-compressor plants located at Empire and Rio Grande, and piping laid to various points. Boiler-inspection service begun. Jurisdiction of mechanical engineer, master car builder, and electrical engineer extended to cover Panama R. R.
Electrical subdivision: Construction of electric lighting plants at Empire and Gorgona. **P-07,** 11, 12.
1908. Duties: Erection, preparation for service, and maintenance in good repair of machinery necessary in canal construction; erection and operation of air-compressor plants; electric installations; manufacture and repair work for other divisions.
Employees: 2,206 men.
Expenditures: $5,645,622.18.
Shops: Three (Gorgona, Empire, and Paraiso) handle all work except electrical installations; each charged with the maintenance and operation of engine houses, coal chutes, and air-compressor plant in its territory. Gorgona shops to embrace 307,000 sq. feet floor space; Empire shops, 198,000 sq. feet; and Paraiso shops, 41,090 sq. feet.

Gorgona shops: One-third of output manufactured material, including 4,279,237 pounds gray iron castings, 50,000 pounds semisteel castings, and 216,947 pounds brass and bronze castings. **P-08,** 14.
Empire shops: 55 of the 101 shovels in use, 55 given general shop repairs, costing $145,479.41 for direct material and labor charges. Cost of general shop repairs to steam shovels per cubic yard, $0.00833. 275,000,000 cubic feet air compressed, at cost of $0.0344 per 1,000 cubic foot.
Paraiso shops: Light repairs handled.
Equipment erected and made ready: "At the end of the year" there had been erected and made ready for service the following equipment: 101 steam shovels, 300 American and French locomotives, 3,451 American and 659 French cars, 20 cranes, 30 unloaders, 9 track shifters (manufactured on the Isthmus), 18 pile drivers (16 made on the Isthmus), 23 bank or earth spreaders, and 46 unloading plows.
Maintenance and repairs: Including operation of air compressors, cost $1,951,618.79.
Equipment costs: Including erection, $2,590,536.94.
Inspections: 77 tests of machinery, etc., including the installation of oil-burning apparatus at various boiler plants. Boiler-inspection service inspected and tested 3,580 boilers. **P-08,** 15.
Electricity: 13,365 16-candlepower lights installed, which would supply all Isthmian Canal Commission settlements. Fire-alarm systems installed. **P-08,** 15.

Power, Motive. (See No. 221, p. 2366 of this Index.)
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Prices. (See Nos. 3, 214, pp. 2361, 2365 of this Index.)
Materials to be purchased from lowest responsible bidder, act relating to, **P-11,** 560.

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Culebra division, disadvantages of Culebra division in a comparison with U. S. work, **P-08,** 42.

Projects. (See Nos. 2, 3, 5, 6, 8, 14, 15, 17, 18, 170, 171, 172, 173, 183, 185, pp. 2361, 2365 of this Index.) (See Acts; Treaties.)
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(a) Projects, 1486-1899—Historical surveys, etc.
(b) Projects (Nicaragua *v.* Panama), 1899-1901.
(c) Projects, Panama route, 1905-1908. (Embracing consideration of the plans of Isthmian Commission Nos. 1, 2, 3, and of plans proposed by Board of Consulting Engineers of 1906, for lock evel or sea level canal.)
(d) Projects, adopted or official project of 1909.

(a) Projects, 1486-1899.
1486-87. Portuguese explorations for a route to India. Discovery of the Cape of Good Hope accidentally. **P-99,** 18.
1487-1499. First voyage around Africa to India. Great stimulus of trade by new route, placing Portugal among the foremost nations of Europe. Voyages of Columbus and discovery of America. **P-99,** 19.
1513. Balboa discovers the Pacific.
1515. Balboa transports material for exploration ships across the Isthmus, **P-99,** 20.
1519-20. Magellan discovers Straits of Magellan as an entrance to the Pacific. * * *

For the first time a continuous voyage had been made around the world. * * * "But this western passage did not reduce the distance nor satisfy the wishes of those who sought a direct way thither (to the far eastern countries) by the discovery of a connecting strait along the coast line of the new continent." * * * "Efforts to discover it (the supposed isthmian strait) were still prosecuted, but they were mainly confined to the isthmian section, from Mexico to Darien, where it had been developed that the two oceans were least widely separated." **P-99,** 21.

1516-1523. Charles V of Spain charged the governors of his American provinces to have the entire coast line thoroughly examined, etc., in search of a passage which would connect the eastern and western shores of the New World and shorten by two-thirds "the route from Cadiz to Cathay." Lake Nicaragua found.

1517-1521. City of Panama founded. Road built across the Isthmus, crossing the Chagres. **P-99,** 23.

1519. Line of posts established across Isthmus, Nombre de Dios being founded as the Atlantic port, old Panama as the Pacific port. **P-99,** 22, 23.

1520-1527. Cortes after conquering Mexico explored adjacent coasts. Constructed vessels on coast near Tehuantepec. Discovered Gulf of California. Course he followed across divide became an important route of communication between Atlantic and Pacific. **P-99,** 23, 24.

1529. Capt. Machuca undertook exploration of Lake Nicaragua and its eastern outlet, and finally reached the Atlantic. At a later period sea vessels passed regularly up and down the San Juan. This commerce maintained as late as 1637. **P-99,** 22, 23.

1520-1534. Royal decree that space between the Chagres and Pacific be examined, with a view to effecting communication between the navigable waters of the river and the ocean. The governor, Pascual Andagoya, reported that such a work was impracticable, and that "no king, however powerful he might be, was capable of forming a junction of the two seas or of furnishing the means of carrying out such an undertaking." Under Philip II of Spain the policy with regard to the isthmian transit changed. Why seek an unobstructed strait? Trade was good enough. Opening a canal would be flying in the face of the Almighty who had thought it wise to make none. Besides, an opening might afford access to enemies of Spain. This policy ruled for two centuries, though the connection between the two oceans was often discussed, and many explorations made. **P-99,** 24.

1534. About this time a route by water for boats and light-draft vessels established from Nombre de Dios along the coast and up the Chagres to Cruces. **P-99,** 23.

1597. Porto Bello made the eastern port of entry instead of Nombre de Dios, latter being so unhealthy as to be termed the "sepulcher of the Spaniards." **P-99,** 23.

1585. Commerce of the Isthmus increased amazingly, and reached its height, 1585, when Panama was called the tollgate between western Europe and eastern Asia. Spain greatly enriched through her establishment of this isthmian route. **P-99,** 23.

1695. Scotch Parliament authorized the formation of a company to trade from Scotland to Africa and the Indies. Known as the Darien Co. In 1698 sent out 1,200 men. Scheme originated with William Paterson. Vessel anchored in Caledonia Bay, yet known by that name. Paterson's plan contemplated establishment of settlements and ports on both oceans. The new colony declared freedom of trade and freedom of conscience in matters of religion. Colonists became discouraged. Climate unhealthy. Only a small remnant returned alive. Several attempts made to revive the colony (Port Escoces). Spain protested that her territory was invaded. Force used; 2,000 lives lost. Project abandoned. **P-99,** 25.

1771. Bronze cannon accidentally discovered, in Mexico, to have been cast in the Philippines, suggested ascertaining if they had not been imported through an isthmian route. Investigation showed they had come in through old Tehuantepec route. Viceroy of Mexico had 2 engineers, Augustin Cramer and Miguel del Corral, survey the Isthmus, hoping to discover water communication. They reported that in one place the mountains formed a group rather than a continuous chain, that a valley existed through which a canal of small dimensions was practicable, connecting two rivers on opposite slopes, which would form a continuous communication across the Isthmus. **P-99,** 26.

1774. Determined effort made to bring Indians under subjection because of their interference with traffic over the various isthmian routes. Military posts were again established on both sides of the Isthmus. Trail cut which was afterwards known as Ariza's Road. But in 1790, posts abandoned. **P-99,** 26.

1779-1781. Under orders of Charles III of Spain, investigation undertaken by Manuel Galisteo to determine practicability of connecting Nicaragua lakes with Pacific. Report discouraging. Lake Nicaragua 134′ higher than Pacific, and high mountains between lakes and the ocean. In spite of this, company formed, but project never commenced. **P-99,** 26.

1780-1786. Galisteo's party was accompanied in a private capacity by British agents; territory claimed in name of Mosquito Indians. Country invaded by British after Spain had declared war against British. Admiral Nelson (then captain) was in charge of naval operations. In his dispatches he spoke of his intention to "possess the Lake of Nicaragua, which for the present may be looked upon as the inland Gibraltar of Spanish America." Invading force was successful, but it was depleted through sickness due to constant rains, fevers, etc. Nelson's life was saved only by careful nursing. Treaty of 1783 terminated the war; Great Britain relinquished whatever territorial rights she claimed in that region, retaining only some rights of woodcutting for dyeing purposes. In 1786 the Spanish sovereignty was again confirmed by the British, but treaties disregarded later after Spanish colonies acquired their independence. (Mosquito tribes, 1894, agreed their territory should become a department of Nicaragua.) **P-99,** 27, 28.

1814-1823. Spanish Cortes, aroused by remarks of Baron Humboldt deploring lamentable lack of knowledge concerning isthmian regions, decreed, 1814, for the construction of a canal through the peninsula for vessels of the largest size, and authorized the formation of a company therefor. No results. Spain's opportunity of making an isthmian passageway terminated 1823, when the last of her central American Provinces seceded. **P-99,** 28.

1819. Republic of Colombia formed from New Granada, Venezuela, and Ecuador. **P-99,** 28.

1823. Guatemala, San Salvador, Honduras, Nicaragua, and Costa Rica established Republic of the United Provinces of Central America, **P-99,** 28.

1824. Mexico had reconnaissance made of Tehuantepec route by Juan de Orbegoso and Tadeo Ortiz. Examination showed the great difficulties of making a navigable canal. Carriage road recommended. (See H. R. 322, 25th Cong., 3d sess.) **P-99,** 31.

1825. Republic of Central America proposes to U. S. cooperation in the building of a canal through Nicaragua. Mr. Clay, then Sec. of State, made favorable response. U. S. representative asked by U. S. for information for guiding the U. S. in the matter. No definite action appears to have been taken. A private concern, headed by A. H. Palmer, New York, had previously made proposals to the Republic looking toward a canal. **P-99,** 29.

1826. President Adams instructed commissioners to a proposed congress of nations at Panama, that subject of canal might be well considered; that the benefits of it ought not to be exclusively appropriated to any one nation, but should be extended to all parts of the globe upon the payment of just compensation or reasonable tolls, **P-99,** 29.

The Republic of Central America, not waiting for action by U. S., accepted terms of Palmer, and made contract. (See Report 145, H. R., 30th Cong., 2d sess., pp. 362-367). Palmer sought to capitalize a company at $5,000,000; sought English money; was unsuccessful. **P-99,** 29, 30.

Survey of Nicaragua route made by John Baily, who had been sent out by an English company wanting a concession. Local authorities employed him to make the survey. He favored a route from Greytown to Lake Nicaragua, across the lake to the Lajas, thence to the Pacific. He proposed canal for ships of 1200 tons burthen, depth of 18′. Recognized difficulties of the work. Alternative plan embraced a tunnel. Suggested also route through the Tipitapa and Lake Managua. **P-99,** 31.

1827. J. A. Lloyd explored the Isthmus of Panama under authority of President Bolivar. Recommended new line instead of those in use from Porto Bello and Chagres by Cruces to Panama, beginning at Bay of Limon via Chagres River and Trinidad River. Made no definite recommendation in favor of a canal. **P-99,** 32.

1830. Central American Republic negotiated with Netherlands company for canal. U. S. announced that it would consider itself entitled to all advantages accorded other nations over such a canal through Nicaragua. Project abandoned. **P-99,** 30.

1835. Central America again turned to the U. S. on subject of Isthmian Canal. President Jackson sent Mr. Biddle to examine Nicaragua and Panama routes. In 1837 Senate informed that it was not expedient to take up subject of Isthmian Canal. **P-99,** 30.

1838. Aaron Clark, with citizens, memoralized Congress on the value of an Isthmian Canal, and asked that engineers examine for routes. Interesting and valuable report rendered by C. F. Mercer, 1839 (25th Cong., 3d sess., H. R. No. 322). No notable action. President Van Buren sent John L. Stephens to the Isthmus. Nicaragua route recommended by him; estimate for canal there, $25,000,000. Times not favorable because of unsettled and revolutionary character of the country. **P-99,** 30, 31.

New Granada, formerly a part of Colombia, in control of the Panama route, granted concession for roads, canals, etc., to French company; latter made explorations for about 2 years; represented to French Government there was a depression of about 37′ above sea vicinity of Panama. French Government sent out Napoleon Garella; latter approved some portions of Lloyd's project; low depression not findable; tunnel proposed, 34 locks with some guard locks; estimate, $25,000,000 or $28,000,000, for boats of 1,200 tons, 198½′ long, 45½′ wide, requiring channel depth of 23′ (H. R. 322, 25th Cong, 3d sess.); this report disappointing; no steps taken; concession forfeited. **P-99,** 32, 33.

1846–1848. Extension of Pacific boundaries of the U. S. and discovery of gold in that quarter produced important travel across Isthmus of Panama. U. S. treatied with New Granada for right of transit across Isthmus. **P-99,** 33, 445.

1847. New Granada granted to Panama Co. (association of French represented by Mateo Kline) the exclusive privilege of building a railroad between the two oceans, across the Isthmus, for 99 years. Company failed; contract forfeited. **P-99,** 37.

1848–1855. New Granada transferred Kline contract to Aspinwall, Stephens, and Chauncey, who organized the Panama R. R. Co. Road opened to public use 1855, from Aspinwall, or Colon, to Panama, 47⅜ miles. **P-99,** 37.

1849. U. S. Congress authorized surveys of certain routes for canal and railroads across Isthmus. Importance of canal recognized, but railroads favored meantime. Further surveys recommended. (H. R. 145, 30th Cong. 2d.) **P-99,** 33.

Aspinwall, Stephens, and Chauncey memorialized U. S. Congress for subsidy; only $250,000 annually to aid in building the road recommended; no action; annual appropriation made for carrying mails across Isthmus. **P-99,** 34.

Treaty with Nicaragua by E. Hise, U. S. chargé d' affaires, for transit routes in favor of U. S.; latter to defend Nicaragua especially against pretensions of British to control of lower waters of San Juan; treaty not ratified by U. S.; Hise succeeded by E. G. Squier; latter negotiated treaty in behalf of American company composed of Cornelius Vanderbilt and others; not ratified. Both treaties, however, subjects of Clayton-Bulwer treaty 1850. **P-99,** 34.

1850. Clayton-Bulwer treaty, July 5, 1850, agreed, among other things, that the two contracting parties (England and U. S.) would support or encourage such persons or companies as might first commence adequately a ship canal through Nicaragua, which terms embraced any contract pending, this latter provision in the interest of the company Squier had negotiated for. This latter company, the American, Atlantic & Pacific Ship Canal Co., incorporated in Nicaragua. **P-99,** 34, 35.

Col. O. W. Childs, Philadelphia, appointed the chief engineer of the canal project of the A. A. & P. Co., to make a careful instrumental survey from ocean to ocean for a line of location. **P-99,** 35, 71.

1851. The A., A. & P. Ship Canal Co. acquired a separation of its contract; getting a charter for an additional company which would establish a transit route across the Isthmus separate from the canal project. This accessory company maintained a line from Greytown, up the San Juan, across Lake Nicaragua to Virgin Bay, thence by stage coaches 13 miles over a good road to San Juan del Sur. Route much traveled for years, in connection with the influx of settlers to the Pacific coast. **P-99,** 34, 35.

1852. Col. J. J. Abert and Lt. Col. W. Turnbull, U. S. topographical engineers, at the desire of President Fillmore, inspected the Childs report of the surveys made across the Isthmus; reported plan practicable; recommended some changes. Representatives of the British Government were selected by the latter; commended the nature of the information obtained by Col. Childs; recommended channel 20′ by 50′, and locks of 300′. Nothing further in this connection done by the A., A. & P. Ship Canal Co. **P-99,** 36.

1855. The Panama R. R. was increasing the desire for waterway transit across the Isthmus, the U. S., Great Britain, and France being among the most active in exploring probable routes and in searching out traditional lines of passage. Three lines received major attention: The San Blas, Caledonia Bay, and the Atrato. Exploring parties sometimes aided by the respective Governments. No easy routes found. (Report, Isthmus of Darien, made to Sec. of Navy, by Lt. I. G. Strain, 1854; Sen. Ex. Doc. 1, 33d Cong., 2d sess.; and report, Lt. John T. Sullivan, U. S. Navy, 47th Cong., 2d sess., H. Ex. Doc. 107.) **P-99,** 37, 38.

1856. The President of Nicaragua claims that the project of the A., A. & P. Ship Canal Co. had been abandoned, and decree was issued revoking and annulling contracts made with the company; protest made by the company unavailing. **P-99,** 36.

1858. Nicaragua and Costa Rica united to grant a concession similar to the Squier concession, to Felix Belly, of France, to construct a canal from the mouth of the San Juan, by way of the river and Lake Nicaragua, to the Pacific, to be executed by a company to be formed, the French

Government to have the right to keep two war vessels on Lake Nicaragua. U. S. declared the latter provisoin obnoxious. Company failed; concession annulled. **P-99,** 36.

1866-67. In response to Senate resolution, Sec. Wells transmitted report of Rear Admiral C. H. Davis (S. Ex. Doc. 62, 39th Cong., 1st sess.), on results of isthmian examinations. Accompanied by general maps of the Isthmus routes. 19 canal and 7 road projects enumerated. Excluded from further consideration the Tehuantepec route and the Honduras as possessing little merit. With reference to 8 routes in Nicaragua, stress was laid on the obstacles connected therewith; suggestion made that easier routes might be found elsewhere. Further examination in detail much needed before it would be reasonable to determine the most practicable route across the Isthmus. Belief expressed that the Isthmus of Darien should be looked to first for a solution of the problem. **P-99,** 38.

1868. Nicaragua and Costa Rica contracted with Michel Chevalier, of France, for the same object as in 1858. Company failed; contract annulled. **P-99,** 37, 115, 425.

1869-1872. President Grant's first message to Congress commended an American canal on American soil. Congress promptly responded by providing for further explorations. In 1872, Congress authorized the appointment of a commission (Interoceanic Canal Commission). Members: Gen. A. A. Humphreys, Chief of Engineers, U. S. Army; C. P. Patterson, Superintendent Coast Survey; Commodore Daniel Ammen, Chief of the Bureau of Navigation, U. S. Navy. Commission studied examinations which had been made, those in progress, and assumed authority over others to be made. In 1870 Capt. R. W. Shufeldt recommended canal line beginning at the head of navigation in the Coatzacoalcos, to dividing ridge at Tarifa, thence to harbors of Salina Cruz, the Pacific terminus. Proposed canal to be 144 miles long, with 140 locks. (S. Ex. Doc. 6, 42d Cong., 2d sess.) **P-99,** 39.

1870-1873. Commander T. O. Selfridge, U. S. Navy, was directed to make a survey of the Isthmus of Darien; large force, assisted by 3 vessels. (H. Misc. Doc. 113, 42d Cong., 3d sess.) **P-99,** 40.

1872. Nicaragua route examined by Commanders Hatfield and Lull, U. S. Navy. A. G. Menocal served as chief civilian engineer. The survey followed the Childs route principally. (S. Ex. Doc. 57, 43d Cong., 1st sess.) **P-99,** 39.

1874. Interoceanic Canal Commission also studied report on Nicaragua route made by Maj. W. McFarland, Corps of Engineers, U. S. Army, who went over the country; report favorable; rough estimate of 26' canal, $140,000,000. (S. Ex. Doc. 46, 52d Cong., 2d sess.) **P-99,** 39.

1875. Capt. E. P. Lull and Mr. Menocal made careful instrumental examination of Isthmus of Panama, along the line of the railroad. Reported in favor of line 41.7 miles long, from the Bay of Limon to the Chagres, to the divide, thence to the Bay of Panama. (S. Ex. Doc. 75, 55th Cong., 3d sess.) **P-99,** 40.

1876. The Interoceanic Canal Commission unanimously reported in favor of the Nicaragua route—beginning at Greytown, thence to San Juan River, thence to Lake Nicaragua, through the valleys of the Rio del Medio, and the Rio Grande, to Brito, on the Pacific coast. (S. Ex. Doc. 15, 46th Cong., 1st sess.) **P-99,** 40.

1876-1877. Provisional company organized France for waterways across the Isthmus. Contract made through Lt. L. N. B. Wyse, with Republic of Colombia, giving promoters privilege for 99 years, without any restriction of an important character; general route to be determined by an international congress of engineers and others about 1881. **P-99,** 40, 41.

1879-1881. International Scientific Congress assembled Paris, 1879. Decision reached that the best line for a maritime canal across the Isthmus was from the Gulf of Limon to the Bay of Panama. Concession transferred to the La Compagnie Universelle du Canal Interoceanique de Panama (Panama Canal Co.), organized 1881. In later years this company failed, and went into liquidation. The new Panama Canal Co. undertook its work. **P-99,** 41.

1881. J. B. Eads proposed a ship railway, by way of Tehuantepec. Charter obtained from Mexico. Belief of many that this scheme most practical and more practicable than canal by any route known. **P-99,** 41.

1884. Treaty had been negotiated between U. S. and Nicaragua, authorizing construction of a canal by the former, to be owned by the two contracting parties, **P-99,** 41, 359.

1885. Foregoing treaty withdrawn in the Senate of the U. S. by the President, in the belief that the perpetual alliance it proposed with Nicaragua was against the declared policy of the U. S., **P-99,** 41.

Nicaragua route again surveyed under authority of Sec. of Navy, by A. G. Menocal, who prepared a special plan. (S. Ex. Doc 99, 49th Cong., 1st sess.) **P-99,** 41.

1887-1889. Nicaragua granted concession to A. G. Menocal and others, authorizing ship canal from Greytown to Brito; like concession secured from Costa Rica. Name of company, "The Maritime Canal Co. of Nicaragua." Incorporated by Congress, Feb., 1889. Failure of construction company; Nicaragua declared contract forfeited; several proposals before Congress for years to aid company. **P-99**, 41, 42, 389, 431.

1895. Bill pending for several years for a board of engineers to ascertain feasibility, permanence, cost, etc., of canal through Nicaragua, passed and approved Mar. 2. Board composed of Lt. Col. Wm. Ludlow, Corps of Engineers, U. S. Army; Civilian Engineer M. T. Endicott, U. S. Navy; Alfred Noble, civil engineer. Designated as "Nicaragua Canal Board." Reported Nov. 1, 1895. (H. D. 279, 54th, 1st) Reported it was impracticable in the short time allowed to make satisfactory examination; recommended further explorations, etc.; tentative estimate, $133,000,000. **P-99**, 42, 82.

1897-1899. Congress authorized continuation of surveys and examinations in Nicaragua, as recommended by Ludlow Board. New board formed—Rear Admiral J. P. Walker, U. S. Navy; Col. P. C. Hains, Corps of Engineers, U. S. Army; Prof. L. M. Haupt, civil engineer. Designation, "Nicaragua Canal Commission." Board reported to the President, May 9, 1899. Route favored practically that of Childs in 1852. Project, however, calls for canal 30′ by 150′, with locks 665′ by 80′. Provision was made also for regulation of lake level, never before adequately dealt with.

At this point in the history of isthmian investigations, the examinations and surveys made under the authority of the U. S. had dispelled all fictions and fanciful views concerning an isthmian waterway passage.

The central American Republics were beginning to realize that the isthmian waterway could be built only through the aid of some powerful nation, instead of by individuals and corporations. There was evidence that these Republics were willing to enter into negotiations toward such an end, provided proper assurances were given that the sovereignties involved would not be disturbed. **P-99**, 42, 43, 82.

(b) Projects (Nicaragua v. Panama), 1899-1901. (See p. 2549 of this Index.)

The subjects embraced by the above title are as follows:

—Choice to be between Nicaragua and Panama.
—Consideration of the respective rights, privileges, and franchises.
—History of the French Panama companies, including consideration of what they had accomplished.
—Canal dimensions, and unit prices for construction, by either route.
—Panama route. Details, sea level, and lock canals.
—Nicaragua route. Details, lock level canal.
—Conclusions favorable to Nicaragua route after comparing the features of both routes.
—Later conclusions favorable to Panama.

Factors considered by Isthmian Canal Commission No. 1:

"The passages to the Orient around the Cape of Good Hope, through the Strait of Magellan and around Cape Horn, have not satisfied the desire for a direct line of communication eastward or westward. The passage north of the American Continent, discovered (by McClure) in 1851, and that north of Asia, first made in 1879, were valuable only as contributions to geographic knowledge, for they are through arctic regions, where the ice seldom permits a continuous voyage. Lines of transcontinental railroad connecting Atlantic and Pacific ports have facilitated travel and commercial intercourse, but they have not filled the place of a ship canal. The reopening of the ancient communication, mainly upon a new line, between the Mediterranean Sea and the Indian Ocean by the completion of the Suez Canal in 1869 has made the interoceanic connection westward of less importance to the people of Europe, but it has had little effect on the American Continent. The demand that the American Isthmus be opened to navigation from sea to sea is each year becoming more imperative. The extension of our territory to include the Hawaiian Islands and afterwards the Philippines has made this connection most desirable for the proper exercise of governmental functions wherever they are to be discharged." **P-99**, 43.

Probable choice of routes to be made between Nicaragua and Panama. (See Physical Characteristics; Routes.)

RIGHTS, PRIVILEGES, AND FRANCHISES. (Chap. VIII.) **P-99**, 115-160.

Contents: Requirements of law as to investigation; proposition before Congress was that U. S. should construct, maintain, and operate a navigable waterway through territory of foreign States; can not be done, "under law of nations," without "their" consent. Sovereignty of U. S. over canal route not requisite. **P-99**, 115.

Strip or zone 5 miles wide from center thereof on each side recommended; U. S. "should have power to protect the entire line from intrusion by evil-disposed persons, prevent smuggling, regulate the kinds of business that ordinarily require control, and enforce police, sanitary, and other appropriate rules and regulations, as well as contracts relating to the construction and operation of the canal," **P-99**, 116.

If rights, privileges, and franchises exist, they should be removed. Treaties to be examined. **P-99**, 116.

Treaties relating to Nicaragua route (see Treaties): Costa Rica also interested. Treaty between U. S. and Nicaragua, 1867. **P-99**, 116.

Frelinghuysen-Zavala treaty, 1884, **P-99**, 117.

Two treaties between Nicaragua and Great Britain, 1860, P-99, 118.

Between Nicaragua and France, 1859. Other treaties by Nicaragua with other countries. P-99, 119.

Relation of Clayton-Bulwer treaty (1850) to Nicaragua; "entered into for the purpose of setting forth and fixing the views and intentions of the two contracting parties (U. S. and England) with reference to any means of communication between the Atlantic and Pacific Oceans, by the way of the River San Juan and either or both of the lakes of Nicaragua and Managua to the Pacific Ocean," P-99, 119.

Through Clayton-Bulwer treaty of 1850 Great Britain and the United States declared that neither would ever obtain or maintain for itself any exclusive control over the proposed communication by canal—

That neither would ever erect or maintain any fortifications commanding the same or in the vicinity of, or occupy, fortify, or exercise any dominion over Nicaragua, Costa Rica, or any part of Central America—

That neither would use any alliance or influence that it might possess with any State or Government through whose territory the said canal might pass for the purpose of acquiring for the citizens or subjects of the one any rights or advantages in regard to commerce or navigation through the said canal which should not be offered on the same terms to the citizens or subjects of the other.

In case of war between the contracting parties, it was agreed that the vessels of each country should be exempt from blockade or capture by either of the belligerents while traversing the canal or near either of its ends.

They further agreed to protect the canal when completed and guarantee its neutrality, so that it might be forever open and free and the capital invested in it secure.

They agreed to invite every State to enter into similar stipulations, so that all might share in the honor and advantage of having contributed to a work of such general interest and importance.

The agreement to establish a general principle; agreed that they would, by further treaty stipulations, extend their protection to any other practicable communications across the Isthmus, whether by canal or railway, particularly to the interoceanic communications by the way of Tehuantepec or Panama. P-99, 119, 120.

Amendment of Clayton-Bulwer treaty proposed by U. S., 1900, not accepted by Great Britain, P-99, 120.

Tabulation of policy with reference to interoceanic canal, P-99, 120.

Concession to Nicaragua Canal Association, 1887. (See Treaties.) P-99, 120.

Maritime Canal Co. of Nicaragua incorporated, act of Congress (U. S.), Feb. 20, 1889. (See Treaties.) Concession of Maritime Canal Co. forfeited, 1898 and 1899. P-99, 121.

Concession to Interoceanic Canal Co., 1898. Company failed to make second payment as guaranteed, due 1900. Concession declared forfeited, 1900. P-99, 122.

Various concessions, embracing rights of navigation of Lake Nicaragua and San Juan River by steam, by Nicaragua Mail Steam Navigation & Trading Co., Atlas Steamship Co., Caribbean & Pacific Transit Co., etc., P-99, 123, 124.

Boundary between Nicaragua and Costa Rica. Treaty between U. S. and Costa Rica, 1852. Treaty between Costa Rica and Spain, 1850. P-99, 124.

Between Costa Rica and Nicaragua, 1869. Other treaties. Policy of Costa Rica, etc., relating to interoceanic canal. P-99, 125.

Concession by Costa Rica to Nicaragua Canal Association, 1888. (See Treaties.) P-99, 125.

Isthmian Canal Commission No. 1 report "on obligations now in force to prevent an agreement with the U. S. relative to a canal" (via Nicaragua and Costa Rica). Former unwillingness of Nicaragua and Costa Rica to have their territories "occupied by another nationality even for the purpose of promoting the commercial and industrial development of the State" passing. Opinion growing that canal can only be constructed with the large resources "and abundant means of a willing Government." Protocols with Nicaragua and Costa Rica, 1900, expressing willingness that U. S. should make canal. P-99, 126, 127.

Treaties relating to Panama route (see Treaties): Treaties with Colombia, or "New Granada," as it was designated prior to 1862. P-99, 127.

Though waters of the two oceans only 30 miles apart, no action taken by U. S. to secure privileges until 1846. Treaty of 1846 securing transit rights, ratified 1848. In return for the advantages and favors acquired, and in order to secure their tranquil enjoyment, the United States guaranteed to New Granada the perfect neutrality of the Isthmus, so that the free transit from the one to the other sea might not be interrupted during the existence of the treaty; the United States further guaranteed the rights of sovereignty and property which New Granada had and possessed over the said territory. P-99, 127.

Treaty of Colombia with France, 1856; with Spain, 1881; various other treaties, P-99, 128.

Contract with Panama Co. (French) for railroad, 1847. Privileges of French company lapsed, 1848. Grant revived, 1848, in favor of Panama R. R. Co. (American). Road completed, 1855. Rights of Panama R. R. Co. P-99, 128, 129.

Contract with Wyse, 1876, for canal. Modification, in behalf of International Inter-

oceanic Canal Association of France. New contract, 1878. Canal route to be determined by international commission of experts. Outline of rights of Colombia and the concession holders, etc. P-99, 129.

Expert commission (135 delegates, 11 from U. S.) after session of 2 weeks decided best location was from Gulf of Limon to Bay of Panama; sea-level canal plan. P-99, 130.

Panama Canal Co. organized to work on Wyse grant, 1881. Failed, 1888. New agreement, 1890, on behalf of receivers. Contract extended to 1904; again, to 1910. (See Treaties.) P-99, 130.

1894 a new company organized, "New Panama Canal Co.," acquiring rights of old company, P-99, 130, 131.

"No treaties exist giving U. S. the right to occupy Nicaragua, Costa Rica, or Colombia for canal purposes," P-99, 131.

Terms must be arranged by diplomatic negotiations. Concessions from Nicaragua and Costa Rica declared forfeited.

Cost to U. S. of acquiring the privilege of entering and occupying the territory of the States through which the different routes extend, P-99, 131.

Nature of title required. Unlimited control by U. S. desirable. Compensation therefore should be definite in amount. Probable bases in determining compensation; Isthmian Canal Commission No. 1 had no power to negotiate. Hise treaty (see Treaties), 1849, with Nicaragua. Contract of Nicaragua, 1849, with American, Atlantic & Pacific Ship Canal Co. P-99, 132.

Frelinghuysen-Zavala treaty, 1884 (U. S. and Nicaragua). Contract between Nicaragua and Maritime Canal Co., 1887. Contract between Nicaragua and Interoceanic Canal Co., 1898. (See Treaties.) P-99, 133.

Contract between Costa Rica and Maritime Canal Co. Way open for direct negotiations with Nicaragua and Costa Rica. P-99, 134.

Way not open for direct negotiations at Panama. Privileges of Panama R. R. Co. continue to 1966; of canal company to 2009. P-99, 134.

Both companies prohibited from ceding privileges to foreign Government. These privileges subject to conditions, etc., which would not give U. S. the control, etc., desired. P-99, 135.

New arrangements necessary if U. S. shall build canal. "Relinquishment by canal company, with consent of Colombia," of its privileges to U. S. "would leave the way open for treaty negotiations between the two Governments to ascertain whether Colombia will consent to the occupation of its territory by the U. S. for the construction of a canal to be under Government control, management, and ownership, etc." P-99, 135.

"The U. S. can obtain from Colombia no concession that does not have the approval of the company, and its concessions do not permit the company to transfer or attempt to transfer its rights to a foreign Government," P-99, 136.

Negotiation with New Panama Canal Co., through President Hutin. Queries propounded by Isthmian Canal Commission No. 1 to company. Delays. Suggestion of company that it reincorporate in New York, and the U. S. become majority stockholder; minority to be New Panama Canal Co., and income to latter protected in opposition to any policy of U. S. to lower tolls. Reference to S. Doc. 188, 56th Cong., 1st sess., pp. 41, 42, relating to sale of its rights. Colombian Government "would give" its consent to company making a sale and transfer "if satisfactory arrangements and conditions could be agreed upon." P-99, 136, 137.

Table representing the intrinsic, or real and absolute, value of the work already done and the other property owned by new Panama Canal Co. up to Oct. 4, 1901, on Isthmus, $109,141,500. In addition, compensation was proposed for the possible profits which might result from operation of canal, ranging from 0.5 franc per ton for a traffic of 7,000,000 tons annually, to 3 francs per ton for traffic of 20,000,000 tons annually. P-99, 138.

Company requested a new examination of its schedules; rejected by Isthmian Canal Commission No. 1, as latter felt sufficient examination had been made, and time of final report was approaching rapidly. Isthmian Canal Commission No. 1 named Nov. 5, 1901, as last date for decision of New Panama Canal Co. P-99, 139.

Before the time set, President Hutin named price given above, but withdrew claim to compensation on future traffic basis "as an act of conciliation." Correspondence with the company. P-99, 140-160.

Documents furnished Isthmian Canal Commission No. 1 by New Panama Canal Co., P-99, 215.

HISTORICAL NOTES RELATIVE TO THE UNIVERSAL INTEROCEANIC CANAL CO. (1880-1894) until the organization of the new company. Preliminary remarks: "Now, the real cause of the downfall of the old Panama Co. was the lack of the serious studies which should have preceded its organization."

CHAPTER 1, 1880-1889: Brief sketch of the discoveries, explorations, and plans for maritime canals on the American Isthmus until 1879. P-99, 197.

The International Congress of Surveys for an interoceanic canal, 1879, P-99, 199.

The first issue of shares, P-99, 201.

The International Survey Commission, P-99, 201.

The Couvveux and Hersent contract; success of the second issue of shares, P-99, 202.

The superior advisory commission for the work, P-99, 203.

Purchase of the shares of the Panama R. R. Co. from the American owners, **P-99,** 204.

The small contracts, 1883–1885. Numerous work yards opened. The highest peaks attacked. Examination by Engineer in Chief of Bridges and Roads Dingler of the entire plan for a sea-level canal. "His report is the only full statement of the question that has been made." Outline of his plan. **P-99,** 204, 205.

The large contracts (1885–1887–1889). Canal work divided into 5 sections. Expert engineers after personal examination did not hesitate to declare that the hopes (engineering plans and methods relating to sea-level canal) entertained by De Lesseps were without foundation. **P-99,** 206.

The temporary canal with locks (1887–88); plan hurriedly made, **P-99,** 207.

Receiver appointed, 1889, **P-99,** 209.

CHAP. II: Receipts to Mar. 8, 1890, 1,329,693,078.74 francs, and expenditures 1,313,418,840.28 francs. Cube of excavations done, 50,641,079,861 cubic meters; metallic parts of locks, over 20,000 tons; plant, especially housed plant, in good order, and probably sufficient for completion of work; dwellings for accommodation of 26,000 to 27,000 workmen. The commission (receivers) estimated value of useful work done, and of machinery at 450,000,000 francs. **P-99,** 209, 210, 211.

CHAP. III: The liquidation (1889–1894). Receiver thought new company might be organized. **P-99,** 211.

Receiver's commission of survey reported it was possible to complete canal in 8 years, with a system of locks having a lift of from 8 to 11 meters, united in groups on each slope; that plant was ample; and that 580,000,000 francs needed to complete work.

1890, L. N. B. Wyse gained from Colombia extension of 10 years. New contract signed Apr. 14, 1893, granting extension until Oct. 31, 1894, to organize new company which should have 10 years to complete canal. By-laws of New Panama Canal Co. filed June 26, 1894; capital, 650,000 shares of 100 francs each—50,000 shares to go to Colombia. **P-99,** 212, 213.

DIMENSIONS AND UNIT PRICES: Greater part of world sea commerce carried on by ships of moderate size. In view of increasing draft of ships, 35′ of water fixed as minimum. **P-99,** 44.

Width of locks fixed at 84′; length, 740′, **P-99,** 44, 45.

Prism of various canals; bottom width of 150′ fixed. Side slopes variable; 1 on 3 in soft earth, and 1 on 2 above water; in firm earth, 2 on 3, and 1 on 1 above a berm 10′ by 6′ under water. In rock, the sides to be vertical from the bottom to a berm 5′ above water, with slopes of 4 on 1 in hard rock and 2 on 1 in soft rock above such berm. **P-99,** 45.

Slope of 1 on 1 in Culebra Cut, and retaining walls where required, **P-99,** 45, 46.

Width of channels, 200′, 250′, 260′, 300′, 320′, 500′, 800′. Locks 788′ to 793′ long from quoin to quoin to give 740′ clear. Twin locks and guard gates provided. Intermediate gates proposed, to lock smaller ships. **P-99,** 46.

All locks to have rock foundations; floors to be protected by concrete inverts. Walls of locks to be concrete mainly; climate favorable to concrete. Culbert linings to be protected by 1″ iron. Gates of steel, based on actual designs made by U. S. Board of Engineers on Deep Waterways (1900) (from Great Lakes to Atlantic Ocean).

Unit prices: Hard rock, $1.15 c. y.; soft, 80 cents. Earth removed, 45 cents c. y.; by dredge, 20 cents. Rock removed, under water, $4.75 c. y. Embankments and back fill, 60 cents c. y. Rock in jetty construction, $2.50 c. y. Stone pitching, $2 sq. y. Clearing and grubbing, Nicaragua, $200 per acre; other routes, $100 per acre. Concrete, in place, $8 c. y. Finished granite, $60 c. y. Culvert lining, brick, $15 c. y.; metal lining, 0.04 cent pound. Metal in locks and sluices, 0.075 cent pound. Allowance for each lock chamber for operating machinery, $50,000. Power plant, each group of locks, $100,000. Timber in locks, $100 M b. m. Sheet piling, spillways, $75 M b. m. Bearing piles, spillways, 50 cents linear foot. Pneumatic work, Bohio Dam, $29.50 c. y. Caisson work, Conchudo Dam, $20 c. y. Railroad, complete, $75,000 per mile. 20 per cent additional for contingencies. **P-99,** 47, 48.

PANAMA ROUTE: (See Projects, 1486–1899, above.) Route surveyed, 1875, by Commander E. P. Lull, U. S. Navy. Recommended canal with locks, 26′ deep, and bottom width of 60′ to 72′. Locks to be 450′ long and 65′ wide. Summit level fixed at 124′ above tide level. 12 locks proposed, on each side. Dam across Chagres River to dam up water supply. Estimate, $94,511,360. **P-99,** 56.

In 1876, the Société Civile Internationale du Canal Interocéanique sent an expedition under Lt. L. N. B. Wyse, of the French Navy to make surveys. He obtained a concession. In 1879 an international congress of experts (majority French), under auspices of F. de Lesseps, recommended canal at Panama location, at sea level, without locks. The Panama Canal Co. immediately organized. Purchased Wyse concession. Two years devoted to surveys and examinations. Operations on large scale began 1883, for sea-level canal 29.5′ deep, and bottom width of 72′, involving excavation estimated at 157,000,000 c. y. Line laid about 47 miles long to obtain curvature. Maximum height on center line of Culebra Cut, about 333′ above sea. Among various schemes to control floods of Chagres, dam proposed at Gamboa; decided later to be impracticable; problem never solved (by Panama Canal Co.). Cost estimated by De Lesseps at $127,600,000 time, 8 years. Works continued on this plan until 1887. Then evident that sea-level canal not completable within estimates. Temporary plan of lock canal adopted; summit level to be supplied from Chagres River with pumps. Company bankrupt, 1889. (See Historical notes relating to Panama Canal Co., above.)-

Receiver's commission, after study, estimated canal could be completed in 8 years; cost of completion, $112,500,000 or $174,600,000. P-99, 56, 57.

Legal difficulties, but New Panama Canal Co. formed. Work continued; by 1899 had removed about 5,000,000 c. y. In 1898 a special commission of 14 engineers (European and American) submitted a report (reproduced in S. Doc. 188, 56th Cong., 1st sess., pp. 43–83); reported canal could be built according to the current project. The engineering problems considered solved, but the continuous financial problem made more difficult by the appearance in the field of the U. S. as a probable competitor in the forming of an Isthmian Canal. P-99, 59.

Plan of the new company involved 2 levels above the sea level—one an artificial lake to be made with a dam at Bohio, to be reached with 2 locks; and a summit level to be reached with 2 locks from the lake. The summit level to have its bottom 68′ above the sea, to be supplied with water by a feeder leading from an artificial reservoir to be made at Alhajuela, in the upper Chagres Valley, the ascent on the Pacific side to be likewise by 4 locks. The canal to have a depth of 29.5′ and a bottom width of 98′. General location, the same as that adopted by the old company. Lock chambers, 32′10″ x 82′ x 738′. Lifts, 26′ to 33′. Cost, $101,850,000, not including administration and finance.

A second plan worked out, apparently preferable, but taking more time. Upper level omitted, the cut through the Continental Divide being deepened until its bottom was 32′ above the sea; Lake Bohio made summit level, fed directly by Chagres; one flight of locks on Atlantic side and one lock on Pacific side omitted; feeder from Alhajuela omitted, but dam there retained. Estimate, $105,500,000. P-99, 59, 60.

Old Panama Canal Co. began its work without adequate knowledge of the physical condition at the Isthmus.

Much physical data gathered by the two companies. Made available for uses of Isthmian Canal Commission No. 1. Found essentially correct. P-99, 60.

Study of plan for canal by Panama route to be built by U. S. Made on a different basis than would be adopted for a commercial corporation. Time of less vital importance; funds problem much diminished. Canal should permit passage of craft of largest size for years to come. P-99, 60, 61.

A great natural difficulty the control of the Chagres River. Excessive rainfall, and precipitous slopes of the valley give river a torrential character. Rose 23′, 1890, in 16 hours. P-99, 61.

Sea-level plan rejected by Isthmian Canal Commission No. 1. Excavation required, about 266,228,000 c. y. Cost of plan, $240,000,000. Time, 20 years. P-99, 61.

Canal with locks simplifies problem of flood control, but introduces the problem of supplying the summit level with water. Total amount required to operate canal for a traffic of 10,000,000 tons per annum, 1,063 cubic feet per second. Study of the flood discharge of the Chagres, and for location of impounding dam. Height of spillway fixed at 85′ above mean tide; spillway to be a fixed weir 2,000′ long. Crest of dam placed at 100′, and top of lock walls and gates at 94′, to make them entirely safe from severest floods. P-99, 62, 63.

Annual flow of the Chagres and the topography of the country favorable to a very large increase in the water supply. Reservoir can be constructed at Alhajuela with a capacity for storing an additional volume 4 times that "now" provided. Overflow disposed of through natural and artificial channels to the Chagres River, thence to sea. P-99, 62, 63.

Canal as projected by the Isthmian Canal Commission No. 1 may be described as follows: Beginning at the 6-fathom line in Limon Bay, a channel 500′ wide at bottom, with side slopes 1 on 3 excavated, curving gently to the left upon a radius of 6,560′, until it reaches a point just inside the jetty of the old Panama Canal Co. Here it changes direction to the right upon a curve of 3,280′ radius, then conducted on a straight line for 2,000′ to a point 2.39 miles from deep water in the bay. For about a mile this wide channel is inside the shore line, forming a narrow but well protected harbor. Near the apex of the second curve the bottom width is increased to 800′ for 800′, for a turning basin. Estimate, for this entrance and harbor, $8,057,707, of which $1,936,991 for work outside the jetty. Annual cost of maintenance, $30,000. P-99, 63 and pls. 21, 22, 23.

Colon to Bohio: Bottom width 150′, side slopes 1 on 3 for 1.86 miles through swamp, reduced to standard used in firm earth, for 12.56 miles to Bohio Locks. Length of level, 14.42 miles. Estimate, $11,099,939, including $151,347 for levees to exclude flood waters and $299,000 for the lower approach, 1,200′ long to the lock. P-99, 63.

Bohio Locks: Double flight of locks; total lift varying from 82′ to 90′ at the maximum; 41 to 45 to each lock; normal lift, 85′. Location that of French company. Estimate, $11,567,275. P-99, 63 and pl. 24.

Lake Bohio: Above locks canal enters artificial lake, known as Lake Bohio. Broad, deep water for first 7 miles. Length of channel, 12.68 miles from the locks to the point where the canal leaves the Chagres. Section extends 0.93 mile farther, to where it enters the cut through the divide. Estimate, $2,952,154, including $434,400 for the upper approach to the Bohio Locks.

Obispo guard gates: Near entrance to summit will be placed a pair of gates 100′ wide, so that if it should become necessary to draw off the water from the summit cut the level of Lake Bohio would not be affected. Estimate, $295,434. **P-99**, 64.

Culebra Cut: The summit cut, 7.91 miles long from the Obispo gates to the Pedro Miguel Locks. The highest point about 5 miles from the Obispo gates, where the bottom of the canal at the axis is 286′ below the natural surface of the ground, this is the famous Culebra Cut. This cut estimated on a basis of a bottom width of 150′, with side slopes of 1 on 1 (cut would probably not be finished with this uniform slope, "this furnishes as correct a basis of estimate as can now be arrived at"). Entire cut to be lined with masonry walls. Broad benches on each side to arrest slides and for P. R. R. "Much has been said about the instability of the Culebra Cut; in point of fact, there is a clay in the upper portion of the deep cut which flows readily when saturated, but which will give little trouble if thoroughly drained; probably nine-tenths of the material would naturally be classed as hard clay of stable character; it would weather somewhat, and the surface might require some repairing with concrete in bad places, a practice common in deep cuttings in Europe. This clay disintegrates rapidly in water, and for this reason the canal prism should be confined between masonry walls. With the provision made for broad benches on each side, on which any slight slides would be arrested, it is believed that no trouble will be experienced. * * * It would probably take 8 years to excavate this section of the canal." Estimate of the 6.02 miles of heavy work, $41,940,480; of the entire 7.91 miles between Obispo gates and the Pedro Miguel Locks, $44,414,460, including the upper approach. Time, 8 years. Excavation, 43,237,200 c. y. Hugeness suggests thorough organization and tools. "Ample ground for deposit of spoil." Cost estimated at 80 cents c. y.; bad management might make it $1 c. y.; good management might make it 60 cents c. y. **P-99**, 64.

Pedro Miguel Locks: Similar to Bohio Locks. Aggregate lift, 54′ to 62′. Estimate, including an adjacent dam, $9,081,321. **P-99**, 65.

Pedro Miguel level: From Pedro Miguel Locks to last lock, at Miraflores, 1.33 miles. Estimate, $1,192,286, including $388,880 for lock approaches at each end. **P-99**, 65, pl. 25.

Miraflores Lock: Lift varying from 18′ to 38′ m. l. w. Spillway required. Estimate, lock and spillway, $5,781,401. **P-99**, 65, pl. 25.

Pacific maritime section: For 4.12 miles beyond the Miraflores Lock canal extends through a low, swampy country, through which the Rio Grande runs. Brings canal to point La Boca, where the Panama R. R. has constructed a large and substantial wharf. Dredged channel 200′ wide, with slopes of 1 on 3, will extend from this point 4.41 miles to the 6-fathom line in Panama Bay. Estimate, $12,427,971, of which $1,464,513 is for work outside of La Boca. **P-99**, 65.

Bohio Dam: Most important structure on the line. 107 borings made; reached rock. Masonry dam held to be safer than earthen dam. **P-99**, 65.

Width, 20′ at top; length, 2,546′. Total height above lowest part of foundation, 228′. Masonry core, 30′ thick at and below elevation −30. From that level it tapers to a thickness of 8′ at top. Estimate, $6,369,640. "Before actual construction a better location may be found," and the cost reduced.

Gigante Spillway: Dam of concrete. Crest at elevation 85, terminating in an apron at elevation 65. Estimate, $1,209,419. **P-99**, 66.

Pena Blanca swamp: Water from spillway will flow across country to this swamp, thence into the Agua Clara swamp by an artificial channel. Estimate, $2,448,076. **P-99**, 67.

Chagres diversion: In neighborhood of Gatun valley contracts; diversion of Chagres needful. Channel made by the Panama Canal Co. not ample. New one necessary. Estimate, $1,929,982.

Levees: Low region above and below Gatun must be protected from overflow, **P-99**, 67.

Gatun diversion: Estimate, $100,000, **P-99**, 67.

Panama R. R. diversion: Estimate, $1,267,500, **P-99**, 68.

Total estimate: Including engineering, sanitation, police, etc., $144,233,358. Total excavation, 94,863,703 c. y., exclusive of excavation for the Bohio Dam and the Gigante Spillway. **P-99**, 68.

Total length, from 36′ depth in Atlantic to 36′ depth in Pacific, 49.09 miles. Alignment good. Sharpest curve having radius of 6,232′, except one at entrance to Colon Harbor, which has a radius of 3,280′. **P-99**, 68.

Alternative line: Shortening distance 1.25 miles. No material saving. Details. **P-99**, 253.

Time of transit: Computed for average ship, one 400′ long, 50′ beam, and 24.5′ draft, 11 hours and 14 minutes. **P-99**, 69.

Advantages of Isthmian Canal Commission No. 1 plan: Simplicity. Control of Chagres. One weir at Bohio instead of two. Reduction of cost.

Value of work done at report of Isthmian Canal Commission No. 1: Considering excavation, plant, etc.—excavation (72,000,000 c. y. excavated by old company, and 5,000,000 by new company), $27,474,033; Panama R. R. stock at par, $6,850,000; maps, drawings, etc., $2,000,000. Total, including 10 per cent for contingencies, $40,000,000. (No special allowance made for plant though cared for. Probably of small value in American methods of building canal.) P-99, 69, 70.

Plates: Locks, Pedro Miguel and Miraflores P-99, pl. 25.
Bohio Locks, P-99, pl. 24.
Gigante Spillway, P-99, pl. 27.
Bohio Dam, P-99, pl. 26.
Special studies: Waste weir dimensions and discharges for Lake Bohio, P-99, 247.
Lock systems, P-99, 179.

Gates, side walls, drawings, middle walls, miter sills, approach walls, culverts and valves, lock floors, time of filling and emptying locks, use of water for lockage of vessels, leakage at locks, single and double locks, P-99, 179–196.

NICARAGUA CANAL PROJECT: Childs's projects, 1852. Routes examined by Col. Childs. Water in canal was to be 17′ deep and 50′ wide on bottom. Dimensions and slopes. Length and cost of canal. Total length of route—western division, 18.588 miles; eastern division, 119.305 miles; summit level, 103.430 miles; across Lake Nicaragua, 56.500 miles (now known to be 70.51 miles). Total cost estimated at $31,538,319.55, which included 15 per cent for contingencies, and the work was to be completed within 6 years from the time of breaking ground. His reasons for limiting the depth to 17′ were that the ratio of increase of the expense of a deeper canal would be very great, and that a canal of the dimensions required for vessels of the largest size would be an injudicious application of means that the company, which had a contract with Nicaragua for a canal big enough to accommodate vessels of all sizes, would scarcely favor or the interests of commerce require. No vessels plying between Atlantic States and eastern coast of Pacific with a draft as great as 17′, and that of 261 steam vessels, mostly English, only 15 drew over 17′, 21 drew 17′, and 225 less than 17′ each at the load line. Childs's project submitted by President Fillmore to Corps of Topographical Engineers, U. S. Army; Childs's plan reported practicable, but some modifications to reduce cost suggested. Col. Childs subsequently proposed a project for a canal 12′ deep with a smaller prism and smaller locks. P-99, 75–77.

Lull's project, 1873: Started out under command of Commander A. F. Crosman, U. S Navy, who was drowned at landing. Commander Hatfield assumed command; investigations showed that Col. Childs's survey of the western portion of his line was correct. In Nov. of the same year Commander E. P. Lull, U. S. Navy, had charge of an expedition to continue work of the Hatfield party. Number of routes examined between the lake and the Pacific; one adopted known as the Medio route. Canal depth, 26′; locks to be 75′ by 400′; bottom width, 50′, 60′, and 72′. Waters of the San Juan to be discharged by the Colorado branch. Total estimate, allowing 25 per cent for contingencies, $65,722,137.

New project submitted, 1885, by a former assistant of Commander Lull, a Mr. A. G. Menocal, civil engineer, U. S. Navy, under the Frelinghuysen-Zavala treaty. Survey had been ordered, to determine advisability of any changes in the route for shortening the canal and diminishing the cost. Radical changes proposed. Instead of following the Medio line, Las Lajas route adopted, the one originally surveyed by Col. Childs, necessitating change of plans for taking care of the waters of the Rio Grande, etc. Dam proposed. Instead of a succession of comparatively low dams, single dam at Ochoa proposed, this dam to create slack water navigation in the river, raising the lake to 110. Ochoa Dam to be of masonry (concrete). Entire surplus water of San Juan to be discharged over crest of the dam. Embankments south of the San Juan, for summit level, not deemed required (later investigations determined them necessary). The divide cut an important feature of this project; almost 3 miles long, nearly all curvature. Elevation between eastern and western flowing waters 280′; impossible to locate canal so as to follow turns of the valley, hence line would cut several spurs. Maximum cutting would have been about 350′. Saving in distance from the Pacific to Atlantic over the Lull route 10.96 miles. Project contemplated depth of 28′; increased in places to 30′. Summit level to be reached by 3 locks on the east side and 4 on the west. Locks, 65′ by 650′. Locks 1, 2, 3 on east side had lifts of 26′, 27′, and 53′, respectively. Locks on the west side had lifts of 26.4′, 29.7′ (for second and third), and 24.2′ to 33.18′ for a tidal lock. 53′ lock to be of rock (cut out of solid rock), the others to be of concrete, etc. Narrow-gauge railroad to be built from Greytown to the dam across the San Juan River, and another between the lake and Brito. Total estimated cost, $64,036,197, This includes 25 per cent for contingencies, but nothing for surveys, hospitals, shops, management, and other necessary expenses. P-99, 79, 80.

In 1889 the Maritime Canal Co. of Nicaragua was granted a congressional charter. Project essentially the same as that of Menocal, 1885, modified in respect to the summit level. This was to be extended on the west side to within 3½ miles of Brito by the construc-

tion of a dam across the Rio Grande at La Flor. Surveys revealed that "continuous" ridges did not exist along the route; necessitating embankments, the construction of which made a somewhat difficult engineering problem, on account of the foundation soils. San Francisco, San Carlos, and other embankments. The Ochoa Dam, originally to be of masonry, modified to be a rock fill backed with earth. Crest of dam fixed at 105′ above mean sea level; its width across top 25′. As the water of the San Juan was to be held at 106 in the vicinity of the dam, a constant discharge due to a head of 1′ over the dam was expected. "This, however, would not have been the case, for the lake would have fallen to 106 or lower in the dry season and the level at the dam could not have been maintained." Maximum discharge of San Juan at Ochoa might sometimes reach over the dam crest 42,500 cubic feet per second, and the combined discharges with the lake at 111 over the dams, weirs, and through sluices were estimated at a maximum of 147,800 cubic feet per second. **P-99,** 81.

On the west side of the lake the summit level was to be continued through the west divide and down the valley of the Rio Grande to a point called La Flor, about 3½ miles from the Pacific, where the valley narrowed to about 1,600 feet. At this place the valley was to be closed and the summit level maintained by a large dam. The latter would produce a large, deep basin into which the floods of the Rio Grande, Tola, and other streams would flow. This large pool would render unnecessary the proposed diversion of the upper Rio Grande into Lake Nicaragua, and thus save about $1,500,000. Locks were to be fixed near western end of dam at La Flor, the combined lift of two being 85′. A third, as a tide lock, was to be located near harbor, lifting from 21′ to 29′. Total cost of canal estimated at $65,000,000, inclusive of 25 per cent for contingencies, but exclusive of interest, commissions, and other charges not coming under the cognizance of engineers.

The project was submitted, 1899, to a board of consulting engineers; considered "unquestionably feasible." Some hazard from San Francisco and other basins, due to probable leakage. Board's estimate, $87,799,570, including 20 per cent for contingencies. **P-99,** 82.

A board of engineers was authorized by Congress Mar. 2, 1895, to make a survey and examination for the purpose of ascertaining the feasibility, permanence, and cost of the construction and completion of the Nicaragua canal by the route contemplated and provided for by an act passed in the Senate Jan. 28, 1895, entitled "An act to incorporate the Maritime Canal Co. of Nicaragua, approved Feb. 20, 1889." Report of this board published in H. Doc. 279, 54th Cong., 1st sess. Report to effect that more specific information, etc., necessary; additional examination and surveys recommended; tentative estimate made of $133,000,000. **P-99,** 82.

Appointment of Nicaragua Canal Commission was authorized by Congress June 4, 1897, to carry out recommendations of former or preceding board. Reported to the President May 9, 1899. Route that of Childs's practically, but project modified somewhat. Canal to be 30′ by 150′ bottom, with locks 80′ by 665′. A single high dam across the San Juan, above the mouth of the San Carlos River, provided for; canal carried thence on the left bank of the San Juan River to the Caribbean Sea. Provision made for regulation of lake level; no prior project had adequately dealt with this. Safety as a principle placed before cost. Found that the discharge of San Juan had been greatly underestimated. New dam site at Boca San Carlos. Future duplicate locks kept in view at La Flor. **P-99,** 83.

The project of the Isthmian Canal Commission No. 1 follows the general route of that of the Nicaragua Canal Commission. Depth of water increased. Locks duplicated and enlarged. New and better site found for dam in the San Juan. **P-99,** 84.

Cross sections, **P-99,** pl. 60.

Beginning at the 6-fathom curve, the entrance to the canal will lie between 2 jetties running nearly north and south, about 1¾ miles northeast of Greytown and passing close to the most westerly bend of the lower San Juan. Entrance to harbor to be 500′ wide and not less than 35′ deep. The width gradually narrows to 150′, after passing a turning basin, the regular width of the canal at the bottom. The head of the east jetty to extend to 6-fathom curve in Caribbean, and is the zero point to which distances along the canal are referred. Estimated cost of entrance and harbor, $2,198,860, covering 2.15 miles. Summing up the various items of the project, as follows, the total estimated cost is $189,864,062, which includes 20 per cent for engineering, police, sanitation, and general contingencies:

Item.	Miles.	Cost.
Greytown Harbor and entrance	2.15	$2,198,860
Greytown Harbor to Lock 1, including approach wall to lock	7.44	4,899,887
Diversion of lower San Juan	....	40,100
Diversion of San Juanillo	....	- 116,760
Lock 1, including excavation	.20	5,719,686
Lock 1 to Lock 2, including approach walls, embankments, and wasteway	10.96	6,296,632
Lock 2, including excavation	.20	4,050,270

Item.	Miles.	Cost.
Lock 2 to Lock 3, including approach walls, embankments, and wasteway	16.75	$19,330,654
Lock 3, including excavation	.20	3,832,745
Lock 3 to Lock 4, including approach walls, embankments, and wasteway	2.77	4,310,580
Lock 4, including excavation	.20	5,655,871
Lock 4 to San Juan River, including approach walls and embankments	5.30	8,579,431
Conchuda Dam, including sluices and machinery		4,017,650
Auxiliary wasteway, including sluices, machinery, and approach channels		2,045,322
San Juan section	49.64	23,155,670
Lake Nicaragua section	70.51	7,877,611
Lake Nicaragua to Lock 5, including approach wall to lock and receiving basins for the Rio Grande and Chocolata	9.09	19,566,575
Diversion of the Las Lajas		199,382
Lock 5, including excavation	.20	4,913,512
Dam near Buen Retiro		125,591
Section from Lock 5 to Lock 6, including approach walls and wasteway	2.04	3,259,283
Lock 6, including excavation	.20	4,368,667
Section from Lock 6 to Lock 7, including approach walls, embankments, and wasteway	1.83	2,309,710
Diversion of Rio Grande		176,180
Lock 7, including excavation	.20	4,709,502
Section from Lock 7 to Lock 8, including approach walls, embankments, and wasteway	2.43	1,787,496
Diversion of Rio Grande		117,580
Lock 8, including excavation	.20	4,920,899
Section from Lock 8 to Brito Harbor, including approach wall	.23	553,476
Brito Harbor and entrance, including jetty	.92	1,509,470
Railroad, including branch line to Conchuda Dam site, at $75,000 per mile		7,575,000
Total	183.66	158,220,052
Engineering, police, sanitation, and general contingencies, 20 per cent		31,644,010
Grand total		189,864,062

P-99, 84, 109.

Table showing amount and length of curvature for the entire line. 56 curves. 49.29 miles. Total degrees of curvature, 2,339° 50′ 30″. **P-99,** 91.

As there are no natural harbors at either end of the canal line, artificial harbors to be constructed. Fine harbor once at Greytown—destroyed by moving sands. Jetties needed to gain and hold 35′ depth. Dredging also required for maintenance. Jetty needed also at Brito, on the Pacific side. **P-99,** 91–96.

Regulation of level of Lake Nicaragua: Dam at Conchuda, 52.9 miles from the lake, would extend the waters of the lake to that point. Regulation to be accomplished with dams across the Rio Grande west of the lake and across the San Juan on the east side, having waste ways, etc., for discharge into the San Juan. Details of the problem. Maximum and minimum elevations not precisely determinable. Discharging capacity of the San Juan. Discharge of lake at any given stage. Slopes of canalized river corresponding to various discharges. Conditions governing the regulation of the gates. Precipitation in wet season. Effect of rainfall not felt immediately. October rainfalls heaviest. Satisfactory control gainable, but more data required. Concurrent rainfall and lake stage records not sufficiently extended. Maximum rainfall anticipated. Rise due to maximum rainfall. Results based on assumption that rainfall in basin is proportioned to that at Granada. Salient features of a contemplated control of the greatest lake elevations in seasons of maximum precipitations. Method of discussion of the regulation data, etc., not free from error. Computations show that the net available storage in the lake must be 6.2′, if the requirements for evaporation and navigation for two dry seasons and an intermediate dry-wet season are to be met. Storage. Not possible to predict elevation of lake. Certain general principles of control procedure set forth in view of the results of the preceding computation. Oct. the month of heaviest rainfall. The general principle of operation of the sluiceways, etc., about as follows: (1) A full lake with surface probably a little above 110 on Dec. 1; (2) wasteway sluices closed at least from about Dec. 1 to some date in the early portion of the succeeding rainy season, or throughout that season if it be one of unusually low precipitation; (3) a variable opening of wasteway sluices, if necessary, during the intermediate portion of the rainy season, so as to maintain the lake surface elevation but little if any below 110 at the beginning of Oct.; (4) the operation of wasteway sluices during Oct. and Nov. so as to reach the first of Dec. with a full lake, or lake elevation probably a little above 110. **P-99,** 96–104.

Velocities in the minimum sections of the canalized river San Juan. Effect of tributaries of San Juan. **P-99,** 104.

Regulation of the lake to be effected with wasteways at the east end of the summit level. Movable dam essential. Vertically moving gates of the Stoney types selected.

Designed to discharge 100,000 cubic feet per second, through 21 sluice gates, with the water in the pool at 104. Depth of water on crest limited to 7'. **P-99**, 104, 105.

Conchuda Dam for regulation of Lake Nicaragua. Details. Most important structure on route. Length, 1,271 feet. Foundation on hard rock. One end in Costa Rica. **P-99**, 105, pl. 69.

Conchuda wasteways. **P-99**, 105, pl. 68.

Locks, Nicaragua. **P-99**, pls. 64, 65, 66.

Locks: Lock No. 1, vicinity of Misterioso; lift, 36½' above mean low tide; in duplicate, as well as all others. Lock No. 2, near Negro Hills; lift, 18½'. Lock No. 3, beyond the Danta; lift, 18½'. Lock No. 4, beyond the Machado; variable lift, 31 to 37'. Lock No. 5, near Buen Retiro; variable lift, 22½ to 28½'. Lock No. 6, near mouth of Rio Tola; lift, 28½'. Lock No. 7, at site once proposed for La Flor Dam, south abutment; lift, 28½'. Lock No. 8 connects with tidewater; lift, 20½ to 28½'. **P-99**, 84–90.

Wasteways provided for disposal of floods in the various pools in the form of overfall weirs. Embankments in eastern division given a freeboard of 5' above level to which the assumed floods would rise. **P-99**, 106.

Wasteways provided in each of the levels between the summit level and the Pacific, **P-99**, 106.

Wasteways, **P-99**, pls. 67, 68.

Retaining walls planned for cuts where the rock has disintegrated, etc., **P-99**, 106.

The foregoing project based upon a careful and detailed examination of the route. Examinations and borings have been as complete as possible. Special explorations made also to clear up rumors about possible better lines of location in interior and near terminals. **P-99**, 107, 108.

Observations made which determined that the mean level of the two oceans would be about the same, with respect to terminals, **P-99**, 108, 109.

Sand and stone for construction are in large quantities. Concrete work stands the climate well. **P-99**, 109.

Railroad for construction purposes necessary; provision made for one from Greytown to the mouth of the Sabalos River, and from the west shore of the lake to Brito. The intervening space can be traversed by boats. **P-99**, 109.

Time of passing through the canal 30 hours for ship of average size, 24.5' by 50' by 400', and 37.6 hours for a ship 32' by 70' by 650'; these dimensions corresponding closely with "the largest ships afloat." **P-99**, 110.

None of the property of the Maritime Canal Co. of Nicaragua would have any value in the construction of the canal, except possibly the canal excavation from Greytown lagoon inland, and this only of value as a part of a channel for the diversion of the San Juanillo River; on account of forfeiture of concession, probable that all work and property of the company owned by Nicaragua. Company had built telegraph and telephone lines; some railroad built, as were some buildings, shops, quarters, hospitals, storehouses, etc.; jetty at Greytown. **P-99**, 110, 111.

COMPARISON OF PANAMA AND NICARAGUAN ROUTES. Conclusions of the Isthmian Canal Commission No. 1 favorable to Nicaragua route.

Selection of an isthmian route must be made between Nicaragua and Panama. Panama route alone is feasible for a sea-level route. Canal with locks preferred. Both routes cross the Continental Divide less than 10 miles from the Pacific Ocean, the Panama summit being about double the height of that in Nicaragua. For more than half its length the location of each route on the Atlantic side is governed by the course of a river, the flow from whose drainage basin is the only source of water supply for a proposed canal. The summit levels, differing but about 20' in elevation (Panama the lower), are formed by lakes—natural at Nicaragua—requiring costly dams and wasteways for their regulation, etc. Water supply features on both lines satisfactory. In constructing the dams, the problem less at Conchuda on the Nicaragua line than at Bohio on the Panama route. Cost of Bohio Dam one-half more. Advantages in the design and construction of dams in favor of the Nicaragua route. Regulation of Lake Bohio automatic; that at Nicaragua dependent on human judgment. Well equipped railroad in existence at Panama; railroad would have to be provided at Nicaragua. Harbors would have to be created at terminals of Nicaragua route; existing harbors at Colon and Panama would have to be modernized. Construction can begin at Panama within one year; at Nicaragua in two years; because of better facilities for handling material, etc., at the former place. Excavation on the Nicaragua route distributed; heaviest on the Panama route at Culebra, etc. Eight years to complete Nicaragua line; probably 10 years for Panama. Length of Nicaragua route, 183.66 miles; Panama, 49.09 miles. Cost of building, $45,630,704 more on the Nicaragua line, omitting the cost of acquiring the Panama property. Annual maintenance and operation of Nicaragua Canal $1,300,000 greater. Panama route would be 134.57 miles shorter from sea to sea, would have less summit elevation, fewer locks, 1,568° and 26.44 miles less curvature. Passage of a deep-draft vessel at Panama, 12 hours; 33 hours for Nicaragua. Risks and delays greater in canal than in open sea. Nicaragua route the most advantageous for all transisthmian commerce except that originating or ending on the west coast of South America. For the commerce in which the U. S. in most interested, that between Pacific and Atlantic ports, European and American, Nicaragua route shorter by a day. The same advantage exists between Atlantic ports of U. S. and the Orient. For U. S. Gulf ports advantage of Nicaragua route nearly two days. For commerce between North Atlantic ports and the west coast of South America the Panama route is shorter by about two days. Between Gulf ports and the west coast of South America the saving is about one day. For sailing ships, not a large factor in the problem, Nicaragua route more favorable. Opening the Panama route could have no large effect on the adjacent country; large trade development of Nicaragua and Costa Rica would be expected were the Nicaragua line constructed. Nicaragua route has slight advantage hygienically. Cost of Nicaragua line, $189,864,062; Panama, $144,233,358. This does not include cost of acquiring concessions from the different Governments, nor the cost of the rights of the Panama Canal Co. (new). Latter estimated by the Isthmian Canal Commission No. 1 as valued at $40,000,000. U. S. should acquire control of a strip of territory from sea to sea sufficient in area for the convenient and efficient accomplishment of the canal, etc. Strip should be not less than 5 miles wide on each side of the center line of the canal, or 10 miles total width. No treaties existing with any of the States within whose territory the two routes lie authorizing the U. S. to occupy its territory for the construction and operation of a canal. Republics of Nicaragua and Costa Rica untrammeled by any existing concessions or treaty obligations; free to grant rights to U. S.; their willingness demonstrated by a protocol. Colombia has granted concessions to New Panama Canal Co.; Colombia hence not free to treat with U. S. An agreement with the Panama Canal Co. to surrender or transfer its possessions must include a sale of its canal property and unfinished work. Negotiations with the company. Price, $109,141,500. This would make cost of Panama route $253,374,858, or $63,510,796 more than Nicaragua route. Compensation which might be asked by the Republics concerned for the rights and privileges required unknown. Some physical advantages by Panama route, and lower cost of maintenance, etc., "but the price fixed by the Panama Canal Co. for a sale of its property and franchises is so unreasonable that its acceptance can not be recommended by this Commission." "After considering all the facts * * * this commission is of the opinion that 'the most practicable and feasible route' for an Isthmian Canal, to be 'under the control, management, and ownership of the U. S.,' is that known as the Nicaragua route." **P-99**, 171–175.

Later conclusions of the Isthmian Canal Commission No. 1 favorable to Panama route. The stockholders of the New Panama Canal Co., Dec. 21, 1901, gave full power to its board of directors to negotiate for the transfer of its property, concessions, and unfinished work to the U. S. Cablegram sent by Marius Bo, president of the company, Jan. 4, 1902: "Admiral Walker, etc. The New Panama Canal Co. declares that it is ready to accept for the totality, without exception, of its property and rights on the Isthmus the amount of $40,000,000, the above offer to remain in force up to Mar. 4, 1903." This was determined to include maps, plans, archives, and records in Paris. 56 parcels of land, amounting to about 300,000 acres, which, with the lands belonging to the railroad company, covered nearly all the ground needed for canal route. Canal company possessed right to about 625,000 acres of land under a Colombian law, of a land grant in the original Wyse concession. Never delimited. U. S. could relinquish this right as factor in any negotiations with Colombia. 2,431 buildings, used for offices, quarters, storehouses, hospitals, shops, stables, etc. Immense amount of machinery, tugs, launches, dredges, spare parts, rolling plant, stationary plant, etc. (No value attached to this by Isthmian Canal Commission No. 1, as any plant used by the U. S. would be more modern; plant of value to the extent it might be used by the U. S.) Work on canal line of value estimated to be excavation of 36,689,965 c. y.; in Chagres diversion, 210,873 c. y.; in Gatun diversion, 2,685,494 c. y.; monetary value, $27,474,033. New Panama Canal Co. transfers 70,000 shares in the Panama R. R., except 1,100 shares, held by a few individuals. Estimated value of shares transferred, at par, $6,886,300. Mortgage bonds to amount of $3,439,000, issued by Panama R. R. at 4½ per cent; $871,000 of these bonds owned by the railroad, but pledged as collateral to the Panama Canal Co.; $1,064,000 in treasury subject to sale or cancellation, leaving outstanding bonds to value of $1,504,000. Railroad had outstanding also $996,000 6 per cent sinking fund subsidy bonds, as an amortization of the annual payment of $225,000 due the Colombian Government under its concession for the period ending Nov. 1, 1910. Railroad owes $986,918 to the Panama Canal Co., mainly on account of the construction of a pier at La Boca. Total liabilities of the railroad estimated at $2,490,918, not counting the sinking-fund subsidy bonds, for which the Colombian Government has received the benefit, and for which it should make allowance to the U. S. in the negotiations for treaty rights. Its cash assets Jan. 15, 1902, were $438,569.33. Railroad owns 3 passenger and freight steamers, about 2,000 tons each. Railroad owns undivided half interest in islands of Naos, Culebra, Perico, and Flamenco, in the Bay of Panama, the Pacific Mail Steamship Co. being the joint owner. Besides its right of way, terminals and wharves, and considerable areas of land, the railroad owns nearly the whole of the town of Colon. The business from constructing the canal will enable the railroad to pay off its indebtedness; its value will decrease with the completion of the canal. Value of the maps, drawings, records, etc., of the Canal Company placed at $2,000,000. Purchase of the rights, etc., of the new Panama Canal Co. for $40,000,000 would make the comparative cost of the two probable routes as follows: Nicaragua, $189,864,062; Panama, $184,222,358. Originally the canal company prohibited absolutely from ceding its rights to any nation or foreign Government; applicable also to railroad company; Colombia waived the restrictions, and authorized the Panama Canal Co. to treat directly with the U. S. Liquidator of the old-Panama Canal Co. agreeable to negotiations of the New Panama Canal Co. Agreement between the New Panama Canal Co. and the U. S. would require the approval of Colombia in view of the prohibitory clause named above, and also because Colombia owns 50,000 shares of 100 francs of the stock of the company, of which it could not be deprived without its consent. Following this should come negotiations with the Governments concerned for the necessary territory to be under the control of the U. S.

"The question whether the new Panama Canal Co. can make to a purchaser a valid title to the property formerly belonging to the old company, its predecessor, has been considered and answered in the former reports of the Commission, but in view of its importance in connection with the present offer the results of the investigation made will be again presented."

"The old company, in addition to its canal property acquired under its concession from the Colombian Government, owned nearly all of the shares of the Panama Railroad Co. By purchasing these it obtained the control of the concession under which the road had been built. The latter concession will continue in force until 1966; the canal concession is to run for 99 years from the day on which the canal shall be opened to public service, and the date fixed for this in the concession, according to its latest extension, is October 31, 1910. When these periods expire, the different properties are to belong absolutely to Colombia, without compensation, and the Government is under no obligation to extend either concession."

Isthmian Canal Commission No. 1 possessed of no power to make these latter negotiations, as it belongs to the treaty-making power of the U. S. "* * * There has been no change in the views of the commission with reference to any of these conclusions then reached (referring to a former summing up of the respective advantages, etc., of routes in Nicaragua and Panama). * * * There is, however, one important matter which can not enter into its determination, but which may in the end control the action of the U. S. Reference is made to the disposition of the Government whose territory is necessary for the construction and operation of an Isthmian Canal. It must be assumed by the commission that Colombia will exercise the same fairness and liberality if the Panama route is determined upon that have been expected of Nicaragua and Costa Rica should the Nicaragua route be preferred." "After considering the changed conditions * * * the commission is of the opinion that 'the most practicable and feasible route' for an Isthmian Canal, to be 'under the control, management, and ownership of the U. S.,' is that known as the Panama route." **P-99**, 675-681.

(c) Projects (Panama Route), 1905-1909. (See p. 2549 of this Index.)

The matter under this head is arranged as follows:

—Assumption that plan of Isthmian Commission No. 1 the plan approved by Congress.
—Doubt as to following of sea-level or lock plan.
—Board of Consulting Engineers formed.
—Plans proposed to Board of Consulting Engineers.
—Plan of Bunau-Varilla (see below).
—Plan of Bates.
—Plan of Gillette.
—Plan of Isthmian Commission No. 1.
—Lock-level projects.
—Comparison of lock and sea level plans.
—Sea-level plan of Bunau-Varilla. (See above.)
—Efficiency of lock and sea level plans.
—Recommendation by Board of Consulting Engineers of sea-level plan (majority report).
—Recommendation of lock-level plan, Board of Consulting Engineers (minority report).
—Isthmian Canal Commission No. 3, after reviewing foregoing matter, recommended lock-level plan (one member, Endicott, dissenting in favor of sea-level canal).
—Lock-level plan chosen by President Roosevelt, subject to wish of Congress.
—In 1907 project accepted by Congress.

1905. Assumed by Isthmian Canal Commission No. 3 that project adopted by Congress the one submitted by Isthmian Canal Commission No. 1, and "all construction work done thus far has been under and in accordance with that project." Isthmian Canal Commission No. 2 had under consideration a sea-level project. Difference of opinion concerning advisability of sea-level plan. Board of Consulting Engineers appointed by the President to consider type of canal to be adopted. Isthmian Canal Commission No. 3 obtaining data for this board. **P-05**, 14.

Physical data: "Few engineering works have ever been undertaken with more complete physical data available," **P-05**, 14.

1906. Project of P. Bunau-Varilla: (See below) Plan contemplates lock canal with a high summit level; after its completion, proceeding with its transformation into a sea-level canal. Estimated time, for lock canal, 4 years, with a summit level of 130′. The transformation would require a widening as well as a deepening of all channels above sea level. Widening above water to be done first by the ordinary methods for excavation in the dry, but all excavation below water to be by dredging. Dams to be used to gain electricity for power, making cost of work "low.". Lock gates, etc., to be made deeper than ordinarily, and prism above them to be dredged down to them, in reducing to sea-level plan. Dredgings to be taken through a special lock chamber into Lake Gamboa. Time of completion considered too small. Plan expensive. "If the lock canal is likely to be retained for many years, it should be made for the most efficient service and not be encumbered with modifications in lock construction which would prove inconvenient in use." **P-06***, 30–33.

Projects of L. W. Bates: Three projects presented before Board of Consulting Engineers. Project B contemplates two terminal lakes—one on the Caribbean side formed by a dam at Mindi, called Lake Chagres, having a maximum elevation of water surface of 33.5′ above mean tide; another at the Panama end formed by a dam connecting Ancon and Sosa Hills with each other; and a second dam from Sosa Hill to the high ground on the westerly side of the Rio Grande estuary. Four lockages necessary. Two terminal harbors. Breakwaters for harborage. Project A contemplates a summit level of 27′ only above mean tide, maintained by two dams—one at Mindi and one connecting Ancon and Sosa Hills with the high ground above Farfan Point. Board of Consulting Engineers unanimously of opinion that if project A alone were to be considered it could not be preferred to a sea-level canal. Plan B preferred by Mr. Bates. Criticism of Board of Consulting Engineers adverse to its details. Disbelief of Board of Consulting Engineers that "Obispo triangle," to make floods of Chagres flow in opposite directions in canal, would be effective. Control of Chagres by number of small reservoirs not so good as plan of one large reservoir. General nature of Mr. Bates's data. Variant of plan B, called project B′, calls for summit level 95′ elevation; disapproved. The Board of Consulting Engineers' lock-level plan preferable to Mr. Bates's plan B. **P-06***, 26–30.

Correspondence with Mr. Bates relative to the desirability of his presenting the elucidating canal projects for examination by the Board of Consulting Engineers, **P-06***, 247.

New matter in connection with the projects he proposed, **P-06***, 251.

Breakwater at Panama. Disposal of rock from excavations. Cost of rock excavation. Basins kept empty to be ready for flood waters. Gamboa Dam and retention of silt. Mindi Dam data. Navigable capacity of canal. Speed through canals. Speed in curves and tangents. Health record at Panama not so bad as reported. Time of completing projects of Mr. Bates.

Appendices: Tables concerning lockage supply and capacity, low water in the Chagres, requirements of the water supply, prices, and estimates for dams, locks, barrage, etc., **P-06***, 247–265.

Gillette plan: An article which had been printed in the Engineering News, July 27, 1905, was submitted to the Board of Consulting Engineers, embracing a general description of various canal plans, ending with a description and recommendation of a plan for a 100′ summit-level canal. Dam at Gatun; to prevent seepage, steel sheet piles and pipes filled with grout to be used. Straight lines for canal from Gatun to deep water in Limon Bay, "almost exactly the line which has been recommended by the board in the sea-level plan." Three locks, 90′ by 900′, with lifts of 35′, 35′, and 30′ respectively. Suggests floating gates. Estimates considered markedly low; "probable that one cause of this discrepancy is the fact that the board has had the advantage of recent surveys, which show that the maps from which Maj. Gillette worked were inaccurate." **P-06***, 34.

Plan of Isthmian Canal Commission No. 1: (See p. 2549 of this index.) Locks were to have a clear length of 740′ and width of 84′. "If the canal then contemplated were now in existence, it would not afford passage to the largest ships now in course of construction." * * * "The plan contemplated 5 lift locks. * * * The plan under consideration would not fulfill present and future requirements." **P-06***, 33.

The sea-level canal proposed by the majority to be a continuous, winding waterway from Limon Bay to dam near Panama Bay, with duplicate locks near Sosa Hill to overcome difference in tidal fluctuations at two ends of the canal. Prism to have depth of 40′, minimum bottom width of 150′ in earth and 200′ in rock, with suitable side slopes for the former, and practically vertical sides for the latter. Floods of Chagres to be controlled by a dam at Gamboa 180′ above sea level, with sluice gates for regulating discharge through canal. Dams and levees exterior to canal provided for diverting 5 of the 25 streams crossing the canal line, and for preventing overflows in vicinity of Panama.—**P-06***, v, X, 47.

Lock-level project: The Board of Consulting Engineers' lock-level committee submitted 4 projects to the Board of Consulting Engineers. No. 1: Summit level at elevation 85′, to be maintained by a flight of 3 locks at Gatun on the Atlantic side, and with 1 lock at Pedro Miguel, and 2 locks in flight at Sosa Hill adjoining La Boca Pier on the Pacific side, the estimate being $141,236,000. No. 2: Same as above, except that on the Pacific side there are 2 locks in flight at Pedro Miguel and 1 at Miraflores rather than at Sosa; estimate, $148,272,000. No. 3: Based on an elevation at summit level of 60′, maintained on the Atlantic side by a flight of 2 locks at Gatun, and on the Pacific side with a single lock at Pedro Miguel and another at Miraflores. For the purpose of control of the Chagres River and to furnish a water supply there is included a dam at Gamboa; estimate, $171,190,000. No. 4: Summit level at elevation 60′, to be maintained by a dam with single locks at Gatun and Bohio on the Atlantic side, and with single locks at Pedro Miguel and Miraflores on the Pacific side, with a dam at Alhajuela; estimate, $175,929,720. **P-06***, 13.

Comparison of sea-level and lock plans: The Board of Consulting Engineers voted 8 to 5 to adopt for comparison with a sea-level canal, one having a summit level at an elevation of 60′. On the Pacific side there should be 1 lock at Sosa and 1 at Pedro Miguel; on the Atlantic side, 1 lock at Gatun and 1 at Bohio, all in duplicate; and there should be a dam for the regulation of the Chagres at Gamboa identical with that proposed for a sea-level canal. Plan not conceded to be the most feasible for conversion to a sea-level type; Board of Consulting Engineers not of opinion latter could be carried out. **P-06***, 14, 35.

Sea-level canal: Project of P. Bunau-Varilla. (See above.) Appendix F, Board of Consulting Engineers. **P-06***, 199–246.

First part: General conditions. Future necessity of a sea-level canal. Nature of the difficulties which prevent the immediate sea-level canal construction. Sources of really practical coefficients for the calculation of time of construction. The coefficients adopted by the Comité Technique would show that a delay of 30 years is necessary for the dry excavation of a sea-level canal. Seemingly incompatible conditions.—Immediate opening and sea-level construction; how they can be satisfied. **P-06***, 199–203.

Second part: Justification of the project. General description. Automatic regulation of Lake Bohio. Advantages of the channel selected for leading to the sea the Chagres floods below Bohio. The Chagres problem. The Gamboa Dam compared with the Alhajuela Dam; its superiority. No Chagres sediments to be feared with the Gamboa Lake. The efficiency of Gamboa Lake for control of floods vastly superior to that of Alhajuela Lake. Other advantages resulting from the position of the Gamboa Dam. It gives no vital part to the Bohio Lake for the control of the Chagres floods. Proposed system for the control of floods and the storage for dry seasons. The Bohio Lake an emergency flood controller, which may gradually disappear. Storage for dry season. It will be ample for 50,000,000 tons of traffic. Construction of dam at Gamboa impossible with the spoils of the great cut. Must be a concrete dam. Characteristic features of the internal elements of the Culebra Cut. Many errors committed about this substance. No walls at Culebra are necessary. Instability of the spoils embankments during the rainy season paralyzed for years the execution of the work. A tentative dam of 8′ to 10′ head with the spoils of Culebra a failure. Proofs of the stability of the Culebra argillite when in its original place and under water. Construction of the dam at Bohio. No earth dam on the Isthmus should reach 92′ without a core wall. Neither corroi nor masonry are admissible on the Isthmus, owing to lack of skilled and reliable labor. Earth dam at Bohio to consist of a mountain of clayish sand transported and deposited by water. Estimates of time of the Comité Technique can be reduced in the proportion of 4 to 5.375, according to the Isthmian Canal Commission. "My estimation of the time necessary for the Bohio works not contradicted by the Comité Technique's figures." All the works at Bohio can be made in four years. No fear from the pervious subground below the Bohio Dam. Systems proposed in the past for the control of the Chagres floods. The plans of the Isthmian Canal Commission perfect for a perpetual lock canal; defective if transformation to sea level is contemplated. The Culebra problem. Supply of water to summit level perfect in the plans proposed by Varilla. Why level 130 was chosen for the summit. The summit should not be lower in any case for the first form of the Panama waterway. **P-06***, 203–220.

Third part: Transformability of the canal built with locks into a sea-level waterway. The increased width of 300′ at the bottom not resulting in an "extravagant cost." International navigation to preserve an independent channel of at least 75′ if no increase in the width is admitted. Basic principal of the system of transformation. It has generally been thought that it was impracticable to lower the level without stopping navigation. The canal, when sea-level, will receive the high Chagres waters, controlled and cleaned, from the Gamboa Lake, and the Chagres tributaries will flow into the canal direct between Gamboa and Bohio. No further tributaries to be received below Bohio. Essential conditions of the transformation. Not one inch of the channel devoted to international navigation will be used by the works of transformation. Not a minute of the time of the international navigation locks, not a drop of the water stored for the international navigation, will be used for the works of transformation. Gamboa Lake, already a flood controller and a water storer, to play a third and a most important part. It will receive all the spoils of the great cut. Computation of time of transformation a conservative one. Size, location, and cost of the locks uniting Lake Gamboa to summit level. Extraordinary superiority of excavation on water compared with dry excavation. Good foundations assured for the Gamboa Locks. How to avoid difficulty of constructing the low Gamboa Locks when summit level is reduced. Cost of Lake Gamboa Locks not to exceed $15,000,000. Substitution of dredging for dry excavation during the period of transformation. Principal reasons why the wet method is so superior to the dry one for excavating on the Isthmus. Dredging was preferred to open-air rock excavation during the old Panama Co.'s work, with much less powerful dredges "than are now used." The suspension of dredging at Culebra a fatal mistake of the new Panama Canal Co. Why dredging sometimes failed on the Isthmus. The certain way to reduce expenses by dredging lies in the electric working of powerful instruments. Large decrease in the price of excavation and transformation. A depth of excavation 35′ to 50′ below water level perfectly advantageous for dredges built for the purpose. **P-06***, 220–234.

Fourth part: New prospects opened by the great reduction of price and of time of the works of excavation. The Straits of Panama. The proposed method makes a reality of what was yesterday a dream—the Straits of Panama—which, if built by methods hitherto known, would require three-quarters of a century and $900,000,000 exclusive of interest. The currents due to tides and floods not to exceed 3.3 knots in the Straits of Panama. Excavation required for the Straits of Panama. Unit prices and total cost of the construction of the Straits of Panama. The Panama sea-level tide-locked narrow canal, if made by dry process, will take as much money and time to build as the Straits of Panama, if latter is made by proposed new method. **P-06***, 234–236.

Conclusions: The high-level lock canal first; the Straits of Panama afterwards. Longitudinal profile of the Panama route showing the various points and levels. **P-06***, 237–238.

Memorandum: Omission of sand from concrete. Estimated time required for preparatory works. Time saved by omission of locks. Different costs of dredging on water and on land. Underwater rock breaking not a modern problem. Elements entering into cheap method of transformation of sea level to lock level. Earnings of lock canal should largely, if not fully, pay for transformation into sea-level canal. "My remarks before the Board of Consulting Engineers bearing on 61 different essential points of the Panama Canal problem fully explain the views based on 20 years' study of the great technical problem." Refutation of the popular opinion that the dump cars, locomotives, etc., of French régime were "toys" or inadequate. Equal to European plants. Working capacity hindered by necessarily poor trackage. "Mr. Stevens, chief engineer of the Panama Canal, has nobly declared before the Board of Consulting Engineers that the works made by the French deserved admiration." "The justification of the first Panama company at the beginning was that no human anterior experience was available, and that the only way open was to plunge heroically into the unknown to extract the necessary truth." **P-06***, 238–242.

Second memorandum: Price of dredging on water at the Isthmus. Price of rock breaking. Stone and sand for concrete. Time of construction of the locks. Margins of safety giving full guaranty that the opening of traffic within four years can be surely accomplished. **P-06***, 242–246.

EFFICIENCY OF LOCK AND SEA-LEVEL CANALS: Majority of Board of Consulting Engineers held lock-level canal dangerous because of the lock system required; many curves in sea-level canal; more channel surface in lock canal. In sea-level canal, considerable obstructive current. In passing through, for a small ship the canal at sea level has the advantage by about 36 minutes, provided the number of ships does not exceed 10 per day. If the number of ships exceed 30 per day, the canal with locks has the advantage by about 3 hours. For large ships the canal with locks has the advantage whatever be the number per day. If the number be 10, the advantage is about 36 minutes; if it be 30, the advantage is over 3½ hours. Should there be a current of 2.6 miles per hour, as in a sea-level canal, the time of passage might be greatly increased. Majority of Board of Consulting Engineers claim that locks limit the traffic capacity; that lockages can not exceed 10 per day for each lock, or 20 per day for the pair. The minority point to the experience at the Sault, * * * "and they show that with the double flight of locks proposed, a traffic of at least 80,000,000 tons per annum can be accommodated. Additional locks may be built hereafter if needed." To widen sea-level canal 100′

without deepening it would cost at least $87,000,000; the canal with locks may be deepened easily and cheaply by simply raising the crests of the spillways and the height of the locks. Cost of operating and maintaining locks alone estimated at over $500,000 annually; one lock only for sea-level canal, but $225,000 should be charged against sea-level canal because of turning-out places, etc., totalling $300,000 per annum as the apparent advantage in operating expenses of the sea-level. Against this is to be placed the interest on the additional investment. If the canal at "sea level will cost $132,000,000 more than the canal with locks, * * * the interest * * * amounts to $2,640,000 per annum; that is, the annual fixed charges of the canal at sea level will be $2,340,000 more than those of a canal with locks." As to military points of view, both canals as vulnerable. "Should the U. S. depart from its true policy of making the canal neutral, it will not gain anything in a military point of view by adopting the canal at sea level in preference to the one with locks." "There is one valid argument, and one only, which can be brought against the canal with locks, and that is the difficulty of fixing the dimensions of the lock chambers to provide for the possible enlarged vessels of the future." Majority of B. C. E. propose locks 40′ × 100′ × 1000′, while minority 40′ × 95′ × 900′. Total estimated cost of all the locks and approach walls in the "present" project, including the contingency item of 20 per cent, is $44,425,000. "They can therefore be entirely renewed for about half what it would cost to widen the sea-level canal 100′." The water supply for a lock canal is sufficient to accommodate a traffic of about 50,000,000 tons annually; a dam at Alhajuela could provide an additional supply sufficient for 100,000,000 tons, and the Chagres River with its tributaries can be made to provide still further supplies. Opinion unanimous that if sea-level canal is to be built, it should be built from the first. **P-06***, xiv.

Time of completion: Sea-level type, 12 to 13 years. Lock type, 10 to 11 years. **P-06***, 14.

Resolution by the Board of Consulting Engineers recommending the adoption of plans for a sea-level canal, **P-06***, 14.

Sea-level plan: Details. Alignment and description. Estimate of excavation of a sea-level canal 40′ deep. Harbors: Colon Harbor; Ancon Harbor; Pacific coast harbors. Cross sections of the canal prism. Estimate of cost. Estimate of time. The considerations held to be important. Canal makes a connection between oceans and continents. Interests it will affect vast. Not merely passage, but safe and uninterrupted passage required. Canal will endure for all time. Report recommending signed by Davis, Parsons, Burr, Hunter, Guerard, Tincauzer, Welcker, Quellennec. **P-06***, 47-65.

Plan recommended by majority of board follows essentially the line adopted "heretofore" by Congress, except near the terminals, the depth to be 40′, and the width at bottom to be 150′ where the side slopes are gentle, and 200′ where the side slopes are nearly vertical, as in rock. At the Panama end is to be a tide lock, having a usable length of 1,000′ with width of 100′, and depth over the miter sills of 40′. In Panama Bay the channel is to be 35′ deep at extreme low water of spring tides, which will give the full 40′ provided elsewhere in the canal, except upon rare occasions. To control the Chagres River, a dam of masonry or of earth and masonry, is proposed at Gamboa, just off the line of the canal, built to a height 180′ above the sea, forming a reservoir called Gamboa Lake, of which the maximum flow line is to be at elevation 170, into which the flood waters are to be received (no design submitted). Of the tributaries entering the Chagres below Gamboa, the most important are diverted entirely from the canal and conducted by separate channels to the sea. A number of tributaries would yet remain to be taken into the canal, creating currents of about 2.6 miles per hour. Extensive harbor improvements proposed at Colon. Cost of sea-level plan estimated at $247,000,000. Table of more important streams entering such a canal. Total cost would more likely be $272,000,000. Time required to build canal estimated at from 12 to 13 years; feared by Isthmian Canal Commission that time would be nearer 18 or 20 years. **P-06**, x.

Lock-level plan: Minority report. Reasons given in detail. Presents for comparison with the sea-level plan preferred by the majority of the Board of Consulting Engineers a project with summit level at elevation 85 instead of 60, maintained by a dam and duplicate flights of 3 locks at Gatun; recommended for adoption, "Gen. Abbot preferring a lower dam with duplicate flights of 2 locks at Gatun, supplemented by a dam and duplicate single locks at Bohio, raising the summit level to elevation 85." Colon entrance details. Gatun Dam details. Consideration of the stability of earthen dams. Plan of Gatun Dam. Regulating works. Saving effected by change in location of controlling dam to Gatun. Saving about $11,894,621. Water supply of the canal ample. Details of the summit level. Lake Sosa details. Channel in Panama Bay. Dimensions and cost of channel. Comparison of two lock-level plans of 60 and 85 elevations. Comparison with the Board of Consulting Engineers sea-level project. Relative time for completion of sea-level and 85′ projects. Relative time of transit. Capacity for traffic of the sea-level and 85′ elevation lock plan. The duplicate locks of the latter will afford convenient passage for an annual net registered tonnage of 80,000,000. Fallacy of the theory that locks and other similar structures are unsafe to navigation as adduced by experience. Safety of gates. Guards against disasters of all kinds. Earthquakes not a danger at Panama. Relative safety of ships in the two types of canal not at all unfavorable to a lock-level plan. Land damages. Extensive lakes in the plans of both the lock-level and the sea-level plans would flood large areas (44.6 square miles for sea-level plan, and 118 square miles for lock-level plan). Estimated cost of these lands only $300,000. Relocation Panama R. R. would be necessary by any plan. Estimate in detail for 85′ elevation plan, $139,705,200; does not embrace, nor does the sea-level estimate, allowance for any fortifying. Total excavation estimated at 95,955,000 c. y., of which 53,765,000 c. y. from Culebra Cut. Allowance of 20 per cent made for contingencies. Probable cost of maintenance and operation, $2,360,000 annually. No fear for safety of dams. "The construction of earth dams to retain water 85′ deep is not an untried experiment, as there are many earth dams of equal or greater height, nearly all of them made wholly of earth without a masonry core, and none of them having nearly the mass or the stability of those herein recommended."

Summary of conclusions in favor of recommending lock-level canal: "In view of the unquestioned fact that the lock canal herein advocated will cost about $100,000,000 less than the proposed sea-level canal; believing that it can be built in much less time; that it will afford a better navigation; that it will be adequate for all its uses for a longer time, and can be enlarged, if need should arise, with greater facility and less cost, we recommend the lock canal at elevation 85 for adoption by the U. S." Signed by Noble, Abbot, Stearns, Ripley, and Randolph. **P-06***, 67-101.

Plan recommended by Board of Consulting Engineers minority a canal with locks, following in general the same location as the sea-level plan, but with slight variations therefrom in Limon and Panama Bays. Its controlling feature a dam to close the valley of the Chagres at Gatun, thus creating an artificial lake of which the surface is to be 85′ above the sea, and which is to constitute the summit level. Length of dam, 7,700′; height of its crest, 135′, or 50′ above the water surface. To contain about 21,200,000 c. y. of material, principally spoil from canal prism. Channel 500′ wide at sea level leads from Limon Bay to the Gatun Dam, where is placed a double flight of 3 locks by means of which vessels are lifted into the artificial lake. The lake provides unrestricted navigation for a large part of its length, but becomes more contracted as the Continental Divide is approached, until in the Culebra Cut the width at bottom is reduced to 200′. It finally terminates at Pedro Miguel, where the first lock on the Pacific side is placed, having a lift of 30′. By means of this lock vessels are lowered into another artificial lake created by a dam closing the valley of the Rio Grande, and by 2 other dams closing other depressions, the level of the lake being 55′ above the sea. The crests of these dams are 80′ above the sea. Communication between the lake and Panama Bay is effected by a double flight of 2 locks placed near the shore on the high ground called Sosa Hill. All locks are in duplicate and have a usable length 900′, width 95′, and depth over the miter sills 40′. The depth of the channel is everywhere at least 45′, except in the locks and in Limon Bay, where it is 40′; the depth in Panama Bay, however, being measured from mean tide and not from dead low water. In the lakes the depth is often very much greater, being 75′ near the Gatun Dam, and nearly as much for many miles. The width is nowhere less than 200′ at bottom, and at most places is very much more. The length of the canal from deep water in Limon Bay to deep water in Panama Bay is 49.72 miles. Of this, 19½ miles is over 1,000′ wide, 23 miles is over 800′ wide, 35 miles is over 500′ wide, and 42¼ miles is over 300′ wide. That is, for about half the distance navigation is entirely unrestricted, while for more than two-thirds the distance the channels are 500′ wide or more, and for only one-seventh of the distance, including the locks, are they less than 300′ wide. Estimated cost, $139,705,200. Time to build, 9 years. The plan is the same recommended by the Isthmian Canal Commission No. 1 and adopted by Congress, at least by inference, act June 28, 1902. Some doubt expressed as to stability of Gatun Dam; opposite opinion to effect that there would be no seepage at this or the other dams. Locks larger than any which have heretofore been built; some express opinion they are beyond the limit of prudent design. "So the proposed locks can be made safer than the Poe Lock at the Soo, because they are designed after 9 years of practical experience with that lock, an experience which shows it to be a safe place for a vessel." **P-06***, xiii.

Conclusion and recommendations of Isthmian Canal Commission No. 3: After studying majority and minority reports of the Board of Consulting Engineers on sea-level and lock-level canal at Panama—one signed by 8 members, and one signed by 5 members—the Isthmian Canal Commission No. 3 reported as follows: "* * * The canal proposed by the minority * * * can be built in half the time and a little more than half the cost of the canal proposed by a majority of the board, and that when completed it will be a better canal for the following reasons: (1) It provides greater safety for ships and less danger of interruption to traffic by reason of its wider and deeper channels; (2) it provides quicker passage across the Isthmus for large ships or a large traffic; (3) it is in much less danger of damage to itself or of delays to ships from the flood waters of the Chagres and other streams; (4) its cost of operation and maintenance, including fixed charges, will be less by some $2,000,000 or more per annum; (5) it can be enlarged hereafter much more easily and cheaply than can a sea-level canal; (6) its military defense can be effected with as little or, perhaps, less difficulty than the sea-level canal. * * * And, therefore, we recommend that the plan of the minority be adopted, subject, of course, to such changes as may be found desirable during construction and with the understanding that the works in Limon Bay are to be deferred for the present. The entrance now in use at that place must for the present be used in any event, in order to secure harbor room for the landing of supplies immediately needed. * * * What changes should be made can better be determined hereafter." **P-06***, xvii.

Minority report of Isthmian Canal Commission No. 3: One member of the Isthmian Canal Commission (Endicott) regards a sea-level canal, as proposed by the majority of the Board of Consulting Engineers, a better canal for commercial and military purposes. Less time of transit, less chance of interruption of traffic from accident, maintenance and operation charges would be less; sea-level canal would permit of ready enlargement for enlarged traffic; better, safer, and more capacious from a military standpoint. "An 85′ summit-lock canal once constructed means a lock canal always. If a sea-level canal is desired, it must be built directly without first building a lock canal." **P-06***, xviii.

Lock-level canal: Letter of Chief Engineer Stevens, Jan. 26, 1906, after pointing to some "minor" changes in plan proposed, such as building of locks at Miraflores and Pedro Miguel instead of at La Boca, etc., says: "I therefore recommend the adoption of the plan for an 85′ summit-level lock canal, as set forth in the minority report of the Board of Consulting Engineers," **P-06***, xx.

Lock and sea level canals: The Sec. of War, after summing up the various arguments pro and con, as furnished by the labors of the Board of Consulting Engineers, reports, Feb. 19, 1906, as follows: "I recommend the adoption of the type of canal proposed by the minority of the Board of Consulting Engineers, except so far as relates to the location of the locks at Sosa Hill. * * * Object * * * is the possibility of their destruction by the fire from an enemy's ships. * * * If, however, Sosa Hill will not afford a site with such protection, then it seems to me wiser to place the locks at Miraflores. * * * When I visited the Isthmus a year and a half ago * * * I received a strong impression that the work of construction upon which the U. S. was about to enter was of such world-wide importance and so likely to continue in active use for centuries to come, that it was wise for the Government not to be impatient of the time to be taken or of the treasure to be spent." Expresses conviction in favor of sea-level canal, "but the report of the minority, in showing the actual result of the use of the locks in ship canals, in pointing out the dangers of so narrow and contracted a canal prism as that which the majority proposes, and in making clear the great additional cost in time and money of a sea-level canal, has led me to a different conclusion." **P-06***, vii, viii.

President Roosevelt of opinion that the Board of Consulting Engineers failed to give proper attention to the lessons taught by the Soo Canal, in their study of lock-level and sea-level canals at Isthmus of Panama. "The law now on our statute books seems to contemplate a lock canal. In my judgment, a lock canal, as herein recommended, is advisable. If the Congress directs that a sea-level canal be constructed, its direction will of course, be carried out. Otherwise the canal will be built on substantially the plan for a lock canal outlined in the accompanying papers, such changes being made, of course, as may be found actually necessary, including possibly the change recommended by the Sec. of War as to the size of the dam on the Pacific side." **P-06***, iv.

1907. Project adopted by Congress estimated by Board of Consulting Engineers to cost $139,705,200, exclusive of sanitation and expenses of zone government. Estimates did not contemplate or provide for waterworks, sewers, and paving in Panama and Colon nor was provision made for reequipment of Panama R. R. **P-07**, 34-38.

(d) **Project, Adopted.** (See p. 2549 of this Index.)

1909. Lock-canal project as of Jan. 1, 1909: This project is for a lock canal from the −41′ contour in the Caribbean Sea to the −45′ contour in the Bay of Panama, with a flight of 3 twin locks at Gatun, 1 twin lock at Pedro Miguel, and a flight of 2 twin locks at Miraflores.

The channel from M. 0, in the Caribbean, to the head of Limon Bay, to be 500′ wide on the bottom and 41′ deep at mean tide. The depth throughout the remainder of the canal and in Panama Bay to be 45′ deep below mean tide. The channel from the head of Limon Bay to Gatun Locks to be 500′ wide; from south end of Gatun Locks to M. 23.50, not less than 1,000′ wide; from M. 23.50 to M. 26.50, 800′ wide; from M. 26.50 to M. 27.00,

700′ wide; from M. 27.00 to M. 31.25, 500′ wide; from M. 31.25 to Pedro Miguel Lock, 300′ wide from Pedro Miguel Lock to Miraflores Locks, and from Miraflores Locks to deep water in Panama Bay, 500′ wide.
Breakwaters to be constructed in Colon Harbor on different lines from those established by the minority of the Board of Consulting Engineers. The locks to have chambers 110′ by 1,000′ usable dimensions and to be provided with emergency dams and safety gates.
The summit level extending from Gatun to Pedro Miguel is to be regulated between +82 and +87 by means of the spillway in the dam at Gatun. The level between Pedro Miguel and Miraflores is +55′. These levels are to be maintained by earth dams at Gatun and Pedro Miguel and by an earth dam on the west side and a concrete dam with spillway on the east side of Miraflores.
The principal streams adjacent to the Culebra Cut to be diverted; the Obispo, Camacho, and Mandinga into the Chagres, and the Rio Grande as may hereafter be determined.
The average bottom width of channel in this project is 649′. The minimum width is 300′.
This project provides a two-way canal for the largest vessels now afloat or likely to be in the near future. **P-09**, 352.

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1905. Materials and supplies obtained through various offices in the U. S., the general purchasing office located at Washington. Bids called for on basis of price delivered on the Isthmus. Rates on the Panama steamships from New York equalized for all roads delivering to it. Medical supplies, etc., obtained from medical supply depot of the

Army at New York. Purchases to amount of $9,000,000. List of. Complete inventory of material, etc., acquired from the New Panama Canal Co. found inexpedient. Two steamships purchased to provide facilities for the increased freight and passenger movement; chartered to the Panama R. R. Co. **P-05**, 15.

1906. June 25, 1906, Congress resolved, "* * * that purchases of material and equipment for use in the construction of the Panama Canal shall be restricted to articles of domestic production and manufacture, from the lowest responsible bidder, unless the President shall, in any case, deem the bidder or bidders therefor to be extortionate or unreasonable," **P-06**, 14.

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Although plague, yellow fever, and smallpox have been prevalent in ports to the north and south of Panama, none of these diseases gained a foothold in the city. Plague appearing at La Boca was stamped out. Outbreak of yellow fever at Colon isolated (1 of the 2 cases fatal); 39 cases of smallpox at Colon; 2 deaths. **P-06**, 30.

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Quartermaster.
Reports. (See No. 245, p. 2367 of this Index.)

Quartermaster's Department. Operations.

1905. Quarters: Old houses of the French company made available. Dormitories constructed, and new houses. Quarters assigned under definite regulations; details. Views of hotels. General specification for barracks for laborers. Cottages for married employees; views. **P-05**, 44.

1906. (See pp. 1268, 2364 of this Index.)

1907. Building construction division: Embraces construction of buildings for the different departments and divisions of the Isthmian Canal Commission. 656 quarters for gold employees built; 335 for silver employees (consisting of barracks, bathhouses, cook sheds, kitchens, etc.). 33 buildings built for sanitary department. Larger office quarters constructed at Empire and Ancon. School building built at Culebra, and similar ones begun at other points. Seven mess halls for American employees, and 11 for laborers completed. Large hotel at Tivoli completed. Machine shed, engine houses, pattern shop, etc., numbering 10, completed.

Extensive plants at Paraiso and Empire begun. Commissaries, storehouses, coal chutes, etc., built. Four clubhouses built. Manufacturing plants operated at Ancon and Lirio. Expenditure, manufacturing, $276,884.19. 252 of the 2,265 buildings received from the French repaired; 113 destroyed. A total of 767 new buildings were built; on hand June 30, 1907, 2,919 buildings of all classes. Six buildings begun at Porto Bello. Fire houses, jails, churches, post offices, fumigation houses, etc., built along the line.

Employees: 3,570 men; spent, $4,357,587.57; largest item being $1,432,415.51 for American quarters. $482,502.88 for silver quarters. Hospital buildings, $315,196.57. Supervision and clerical force, $193,763.73.

Architect's office: 145 finished sets of drawings, consisting of 605 tracings, etc. **P-07,** 12, 13.

1908. Building construction: New buildings, 505 during the year; 1,147 American buildings repaired; additions made to 423 buildings. 1,178 French buildings repaired and additions and improvements made to 275.

Expenditures: $3,086,138.01.

Employees: Average, 2,366.

Pay: Gold men, $0.625; silver men, $0.169.

New buildings: $2,181,913.39 spent for these; largest item being quarters for gold employees, $982,771.86.

Total cost: Since American occupation, $9,824,089.15 ($421,882.64 being for wire screening, with which all buildings are inclosed).

Important items of construction done: During the year, 33 hospital buildings, 37 storehouses, 7 fire-department houses, 9 laborers' bathhouses, 26 laborers' range closets, 6 fumigation houses, 5 corrals, 9 schoolhouses, 5 commissaries, 1 clubhouse, 4 post offices, 9 office buildings, 2 lodge halls, 18 standard laborers' barracks, 5 band stands, 2 Gallego mess halls, 5 hotels, 4 jails, 8 powder and detonator houses, 4 markets, 35 shop buildings, 8 laborers' washhouses, 3 bridges, and 200 type quarters for gold employees, There are 24 different types of living quarters for the accommodation of gold employees. Total number of buildings built since U. S. occupation, 1,462; total on hand, 3,313.

Ancon wood and machine shop: Cost, $39,327.87 for labor; 70 men.

Lirio planing mill: Principal manufacturing shop of the division. 56 men. Annual cost, $55,880.59. All millwork for buildings done at this shop.

Ancon stone crusher: Operated to furnish stone for masonry division. 2,002 c. y. stone crushed. Cost, 88 cents per c. y.

Cement plant, Ancon: 17,969 concrete blocks made; cost, 12½ cents per cubic foot.

Costs: Various measures in force for reducing costs. Economic building work stimulated by a comparison of the cost of buildings erected by contract. Principal type of buildings constructed by Isthmian Canal Commission costing from 7½ to 9½ cents per foot for bachelor apartments, and from 11 to 13 cents for family quarters. **P-08,** 18, 19,

1909. Organization: Repairs of buildings, not exceeding $200 in value, placed under the Q. M. department Aug. 1, 1908; the construction work under the various division engineers. Order modified, and effective July 1, 1909, construction and repair of all buildings placed with Q. M. Division of materials and supplies merged, Sept. 1, 1908. into the Q. M. department. On the same date, grass cutting and disposal of night soil and garbage taken over from sanitary department. Physical accountability of property instituted Oct. 1, 1908, with audit by the chief Q. M.

Labor: During the year, 1,093 new employments and 884 reemployments made on the Isthmus; of those appointed in the U. S., 754 arrived on the Isthmus. These figures point to a decrease of over 50 per cent in the number of men employed in the U. S., and 40 per cent in the number of men employed and reemployed on the Isthmus; indicating a more stable population, although there has been an actual decrease in the personnel of the gold force. Steady increase of the unskilled labor force continued until its maximum on Apr. 28, 1909; then 33,699 actually working for the Isthmian Canal Commission and Panama R. R. (largest force on record). Decrease in number of Europeans brought to Isthmus; Spanish Government prohibited emigration to Panama. Assignment of married quarters not guaranteed, beginning Jan. 1, 1908, to those on gold rolls. June 30, 1908, 306 applications for married quarters on file; June 30, 1909, 115 applications from those entitled to quarters and 305 applications from employees not so entitled.

Buildings: Kept in repair; extensive repairs necessary due to climate and insects; minor repairs during last 6 months of the year averaged about $20,000 monthly. New building done by contractors; Isthmian Canal Commission furnished materials. Repairs, etc., done by Q. M. forces.

Transportation: 12 corrals, with 500 mules, 139 horses and ponies, and 136 private animals. Delivery system reorganized to decrease expense.

Supplies: Delay in securing necessary supplies a difficulty, because of distance from available markets and limited transportation facilities to the Isthmus. Annual estimates instead of scattered estimates adopted; and yearly contracts. Specifications being standardized. Storehouses at Culebra and Paraiso consolidated. Main distributing storehouse at Mount Hope. Total value of material received during the year, $9,600,000; stock on hand June 30, 1909, totaled $3,000,000. Two new dynamite storehouses erected.

Inspection of magazines, and special transportation of explosives instituted.

Printing plant: Moved from old administration building at Panama to new structure at Mount Hope; consolidated with that of the Panama R. R.

Sanitary work: Grass cutting; garbage removal, etc., taken over by the various district quartermasters Sept. 1, 1908. Work done costs less; appearance of settlements improved.

Property: New system begun, Sept. 15, 1908, that of U. S. Army. An exact check instituted on all property. P-09, 23, 24.

1910. Department charged with recruitment of labor; care, furnishing, and assignment of quarters; distributing fuel, commissary supplies, and distilled water; construction and repair of all buildings; requisitioning for supplies of all kinds, together with receipt and distribution; cutting of grass and disposal of night soil and garbage as prescribed by sanitary department, and auditing of property returns. In charge of Lt. Col. C. A. Devol, chief quartermaster.

Effective July 1, 1909, construction work connected with quarters and other buildings reduced so as not to warrant maintenance of separate gangs by each construction division for erection of buildings; this and all repair work transferred to Q. M. department. Operation of Dock 14, Cristobal, transferred from Panama R. R. to Q. M. department Dec. 1, 1909. Test inventories having disclosed unsatisfactory methods in handling and accounting for property, storehouses at Gatun, Cristobal Dry Dock, and Porto Bello transferred from Atlantic division to Q. M. department Jan. 1, 1910; on same date storehouses at Balboa and Miraflores in Pacific division also transferred, thus placing all storehouses under Q. M. department. Requisitioning for skilled labor transferred from Q. M. department to chairman's office.

Average gold employees, 4,369; and of Panama R. R., 753; or total of 5,122. 2,890 separations from service, and there were employed in U. S. 1,099, on Isthmus 1,092, and reemployments on Isthmus 967, or total of 3,158, indicating more than 60 per cent of force changed during year, showing usual unstable condition of gold force.

Laborers recruited, 2,519; West Indians, larger part from Barbados. Last recruiting, Jan., 1910, since which date immigration exceeded emigration, and, as work has reached maximum, population of zone furnishes ample labor. There has always been independent immigration from West Indian Islands, but it was not until within last 4 months there has been any such movement on part of European laborers. During this period 2,000 came from Spain and Italy. From beginning of year steady increase in force, until maximum—38,676—reached Mar. 30, 1910, including Panama R. R. and relocation, and is largest force on record. Since that a slight decrease, but total effective force June 30 was 35,578, as compared with 33,493 June 30, 1909.

New quarters constructed, 19 houses for married employees, or 38 families. Eleven buildings, accommodating 29 families, converted into "gold" married quarters. Bulk of new construction at Ancon and Gatun. Under conditions of employment Isthmian Canal Commission obliged to furnish married quarters to all employed prior to Jan. 1, 1908, and all such employees supplied. Of those employed subsequent to Jan. 1, 1908, 525 applications for married quarters. Expansion of work at Gatun created demand for bachelor quarters, and four type 18 houses for 192 bachelors constructed.

Every building on Isthmus utilized, and as progress of work caused employees at Culebra, Empire, and Paraiso to decrease, vacant bachelor quarters have been utilized for "nonhousekeeping married quarters" for employees working at points where unable to secure family quarters. Suites of two or three rooms assigned to each family.

Negroes in quarters remain practically the same—4,925 bachelors and 1,067 families. Increase of 1,300 Europeans occupying Isthmian Canal Commission quarters.

Work performed for sanitary department increased, grass cutting covering largely increased acreage, and increase in population has increased garbage. New incinerator installed at Empire, and new ones erected at Pedro Miguel and Miraflores.

Corral constructed at Ancon; largest on Isthmus; useful after completion of canal. More animals available and used than at any previous period. Unusually heavy loss of mules, due to "swamp fever."

3,078 buildings in zone owned by Isthmian Canal Commission, of which 1,147 acquired by purchase from French. $478,000 expended for new construction and repairs during year in completing 90 new buildings of every class of construction, clubhouses, hospital wards, corrals, engine houses, storehouses, fire stations, markets, schoolhouses, and quarters; 50 constructed by contract. Reduction in unit cost, 30 per cent type 14 and type 17 houses, and 33 per cent in type 18 houses; cost of repairs, $78,980. Four traveling gangs of carpenters and two of painters organized.

Total material received from U. S., 350,000 tons, valued at $10,103,552.34. Local purchases, including coal and oil, $2,094,131.02; 345,185 tons coal and 465,921 barrels fuel oil used. Stock in storehouses at end of year, $4,691,034.10. Experiment of annual contracts for standard articles satisfactory; has diminished time between placing of requisition and delivery of material on Isthmus, resulting in fewer shortages of stock in storehouses.

Transfer of Dock 14 from Panama R. R. resulted in reduction of charges, rate on handling general cargo reduced from 40 cents per ton to 32 cents. Since transfer 100,000 tons handled over dock. Storehouse facilities added at Porto Bello, Gatun, Miraflores, and Balboa.

1911. Transfer of Gatun lumber yard from Atlantic division July 15, 1910; construction of storehouses for care of obsolete material Aug. 24, 1910; transfer of storehouse at Pedro Miguel from mechanical division Oct. 11, 1910; transfer of construction and repair of sidewalks from construction divisions Sept. 1, 1910; transfer of Panama R. R. storehouse at Cristobal Jan. 1, 1911; closing of Lirio planing mill and transfer of work and force to mechanical division Apr. 1, 1911; transfer of scrap operations from Panama R. R. Apr. 10, 1911; and transfer of storehouses containing dredge repair parts at Gatun and Cristobal from Atlantic division Apr. 15, 1911.

Average employees of Panama R. R. and Isthmian Canal Commission at maximum for year in Jan., 1911, when 37,271. Minimum June, 1911, when it fell to 32,690. Average gold employees of Isthmian Canal Commission, 4,552; of Panama R. R. Co., 833; or total of 5,385. 2,896 separations from service—employed in U. S., 987; and employed on Isthmus, 1,488—indicating more than 60 per cent of force changed during year, unstable condition of gold force still ruling.

First year since inception of work no contract laborers brought to Isthmus. Decided falling off in immigration to zone. Excess of arrivals over departures, 4,910, against 21,114 during previous year. Departure of steerage passengers to foreign ports exceeded arrivals by more than 1,600, and probable at least 1,000 were Europeans. Number of West Indian laborers have gone to the brush and can be relied upon no longer for steady work.

New family quarters erected only at Toro Point. Bachelor quarters became available and utilized for nonhousekeeping quarters; at close of year 122 families accommodated. When work in Chagres section closed in spring, all laborers and gold employees of that division in San Pablo and Tabernilla district transferred to other districts and houses made available assigned to employees of other districts unable to secure family quarters.

Total West Indians in laborers' barracks 200 less than at close of preceding year, and of Europeans 1,000 less. Laborers' barracks in territory Bohio to Mamei abandoned. Camps at Santa Cruz, Cucaracha, and Cartagena abandoned and buildings at Santa Cruz demolished and sold.

Two additional traveling gangs were formed, one of carpenters and one of painters, and corresponding reduction of artisans in districts made. Nine buildings and one addition put up under contract at total of $44,429.30, nearly all at Toro Point. Contract price on types of houses erected showed reduction; 29 buildings were taken down in sections and reerected at other points. Total buildings June 30, 1911, 2,985, as compared with 3,078 June 30, 1910. Increase in American buildings and decrease of 112 in number of French buildings; 86 buildings demolished and 109 sold.

Centralization of storehouses under one head resulted in more efficient operation. Surplus stock concentrated at Mount Hope, Empire, and Gorgona, certain classes of material being localized, so that steam-shovel, drill repair parts, and electrical material concentrated at Empire, and air-brake material, lubricators, injectors, car, locomotive, and other similar repair parts concentrated at Gorgona. Policy of stock reduction may make it necessary to resort more frequently to emergency purchases, but it is in line with ultimate economy.

Besides regular delivery work and that performed for sanitary department, teams used in construction of Sweet Water Reservoir at Toro Point; Gatun Reservoir; road work between Pedro Miguel and Corozal; street work at Panama and Colon and on the Obispo diversion. Teams and brakes used by department of civil administration during school year. Loss of mules not as heavy as during preceding year; 54 animals died, were condemned, sold, or destroyed. No mules purchased during past two years and no new saddle horses during past two and one-half years. Majority of stock has been in service on Isthmus four to five years and is beginning to show effects.

Work for sanitary department increased, grass-cutting area further extended. Removal of garbage slightly increased. New incinerator installed at Gatun Nov., 1910, and road built to it from New Gatun. Amount expended by Q. M. department on orders from sanitary department for zone sanitation, $210,403.29, and for hospitals, quarantine, etc., $77,284.48.

Removing French scrap iron and steel and shipping it to States continued, and since Apr. 10, 1911, under direction of Q. M. department. From inception of work to end of fiscal year 28,933 long tons of iron and steel shipped and disposed of at average selling price of $11.86 per ton. In addition, 231,598 pounds old screening shipped and sold at average selling price of $7.75 per cwt.; 58,689 pounds of rope at average selling price of $2.15 per cwt.; 83,188 pounds of rubber at average selling price of $2.01 per cwt.; and 113,904 pounds of hose at average selling price of $2.50 per cwt. Advertisements issued seeking new bids for sale of all French scrap on Isthmus.

Department attends to all purchases on Isthmus, and amount expended in such purchases aggregated $2,440,226.40, of which $1,547,568.71 for purchase of coal from Panama R. R. Co., $772,901.22 for crude oil from Union

Oil Co., $103,703.62 for miscellaneous purchases from the Panama R. R. Co., leaving $15,870.10 for purchase of miscellaneous supplies from local merchants; balance used for postage stamps.

1912. Employees on Isthmus fluctuated during year; Mar., 1910, highest recorded force 38,676; June 30, 1911, 32,690; and June 30, 1912, 34,957 men. While there was decrease between June 30, 1911, and June 30, 1912, of approximately 2,900 men in Atlantic division and on relocation of Panama R. R., this more than offset by increases because of construction of docks at Cristobal under Panama R. R., terminals at Balboa under Pacific division, work of first division of O. C. E., and fortifications. Immigration to Isthmus continued to decrease; excess of arrivals over departures, 3,510. At beginning of fiscal year 941 laborers recruited in Barbados and islands adjacent thereto, to meet demand for unskilled labor, which could not be recruited on Isthmus from unemployed living in the brush. Supply of and demand for labor about balanced at end of year. During last three months of year 1,339 laborers taken over by United Fruit Co. for work in Guatemala.

Average American employees, 4,264; on rolls of Panama R. R., 837; or total of 5,101; 2,123 separations from service—559 persons employed in U. S. and 1,286 employed on Isthmus, indicating more than 49 per cent of force changed.

22 new buildings constructed, at total cost of $26,000; of these, fire station at Cristobal, caretaker's residence at Brazos Brook Reservoir, and type 27 at Toro Point cost $21,000; remaining 19 costing $5,000. Fire station and caretaker's house permanent structures of concrete. 18 additions to existing buildings made, at cost of $71,000; of this $63,000 expended for alterations and additions to Hotel Tivoli. 36 buildings taken down in sections and moved to new locations, at cost of $53,000. 15 buildings demolished, material moved to other points and used in construction of 13 buildings, costing $26,790.30. Of these 51 buildings, 14 removed from Culebra on account of slides and 25 from Tabernilla and San Pablo on account of flooding of lake area. Removal and reerection of American buildings still good, but useless in old locations, accounts for small amount of new construction. Purchase from Pacific Mail Steamship Co. of their undivided half interest in islands in Pacific brought with it 22 buildings, utilized for quarters in connection with fortifications. Of old French buildings, 149 sold, realizing $8,000, and 131 demolished; loss of 280 buildings. Of 2,148 buildings turned over by French, 1904, 850 remain. Laborers' camp at White House and other buildings in Las Cascadas district altered and repaired as quarters for Tenth Infantry, U. S. Army. These alterations and repairs made at expense of $50,000, payable from appropriation for barracks and quarters, U. S. Army.

Analysis of census of occupants of quarters shows decrease of 300 Americans and increase of 700 West Indians in quarters. Number of Europeans remains the same. Of Americans, 210 employees of McClintic-Marshall Construction Co. Census also shows 48 per cent of married men and 20 per cent of bachelors hired prior to 1908. No diminution in demand for married quarters; applications on file June 30, 697; or 54 more than year before.

Few annual contracts made during spring, as on certain classes of stock prospective requirements so small that orders can be placed when needed.

Quantity and value of supplies received from U. S. larger than during any previous year; 504,004 tons of material, with value of $10,517,260.99. This does not include piling nor material for McClintic-Marshall Construction Co. Decrease in cement receipts, but increase in amount of piling and of over 4,000,000′ b. m. in lumber. Large amount of material recovered from work and returned to stock. Central and Atlantic divisions and relocation, part of whose work completed, turned in material to value of $680,000. Clean-ups of repair shops made, and repair parts, fittings, and miscellaneous material turned in in large quantities. Total amount of reduction, including material turned in, $1,652,969.34.

So far, but little of Isthmian Canal Commission's plant retired. Material to value of $193,313.34 surveyed and turned into storehouse for obsolete material, amount remaining, at price-book prices, $369,000. Quantity such that additional facilities had to be provided and addition to storehouse for obsolete material constructed. Property to value of $21,704.65 reissued and $10,708.94 disposed of by local sales from storehouse for obsolete material. Much of obsolete material and equipment advertised for sale Feb.; bids on 18 classes rejected and awards made on 8 classes for $20,858.

On Sept. 26, 1911, contract entered into for sale of all French scrap on Isthmus for $215,000. Approximately 10,000 tons collected for shipment. About 4,603 tons of American scrap collected at Empire and Gorgona shops and stored at Mount Hope. Of this, 1,892 tons shipped and sold in New York at price of $10.35 per ton, the net price being about $5 per ton. Sales of scrap screening, rope, rubber hose, and rubber belting continued. Contract, Oct. 12, 1911, for delivery at New York of screening at $8.25 per cwt., rope at $2.18 per cwt., rubber at $2.10 per cwt., and hose at $2.50 per cwt.

Work for sanitary department, consisting of grass and brush cutting, disposal of night soil and garbage, continued. In accordance with recommendations of a board, grass-cutting areas in various districts plotted and measured and regulations compiled for sanitary inspectors and district quartermasters with reference to method of handling work performed by Q. M. department for department of sanitation. Less grass cutting done since Jan. 9, 1912, as objection raised by sanitary department that keeping grass cut close around quarters not necessary except for æsthetic reasons, and that it could be allowed to grow a foot high, so far as sanitary purposes concerned. As there are no funds available except for sanitary grass cutting, no work of this kind done under existing regulations except on requests by sanitary department. Cost of sanitary work done by Q. M. department, $251,768.07.

Regular delivery work done by Q. M. department continued, and, in addition, delivery service furnished to Tenth Infantry. Horse mowing machines introduced into all districts, which necessitates use of more teams by sanitary department. 24 horses and mules condemned and destroyed, 10 condemned and sold, 6 killed, and 8 died; total of 48. No animals purchased for over 3 years, and service of those in corrals averages over 6 years.

All purchases on the Isthmus aggregated $2,639,416.09, of which $1,540,700.65 for coal from Panama R. R. Co., $978,055.26 for purchase crude oi from Union Oil Co., and $96,176.24 for miscellaneous purchases from Panama R. R. Co., leaving $24,035.94 for purchase of miscellaneous supplies from local merchants. Balance used for postage stamps.

1913. May 27, 1913, Capt. R. E. Wood, U. S. Army, appointed chief Q. M. Force employed increased steadily during first 9 months, until Mar. 26 number reached highest point in history of work; on that date effective working force was 44,733, of which 39,089 on pay rolls of Isthmian Canal Commission and Panama R. R. and 5,644 on pay rolls of contractors handling work on lock gates, emergency dams, and other contracts. Force fluctuated between 34,957, June 30, 1912, to maximum on date specified, and numbered 43,350 at close of fiscal year. In Dec., 1912, necessary to recruit laborers, and 528 received from Barbados during Jan. and Feb., 1913. Decided decrease in immigration to Isthmus as compared with previous years. Excess of arrivals over departures but 3,510. Average American employees on rolls of Isthmian Canal Commission, 4,340; and on rolls of Panama R. R., 870; or total of 5,110. 2,495 separations from service—1,010 persons employed in the U. S. and 1,331 employed on the Isthmus, indicating that more than 57 per cent of gold force changed.

Isthmian Canal Commission has 2,618 buildings in zone, of which 1,856 constructed by Americans and 762 by French. Decrease of 121 from total of preceding year. Buildings located at Nombre de Dios abandoned when this locality ceased to be used as a source of sand supply; sold. In addition, 122 demolished and 4 blown down or destroyed by fire. Those demolished located at Bas Obispo, Culebra, Balboa, and Naos Island, and destruction necessary by reason of work or on account of slides. Those demolished small and of no value. New construction less than at any previous time; 20 buildings put up and 15 additions made. Buildings small and only two cost over $2,000. Additions as a rule chargeable to Hotel Tivoli. Due to slides at Culebra and necessity of transferring buildings from Gorgona and old Balboa, work of removal and reconstruction on large scale. 62 buildings taken down in sections and reconstructed in new locations. Completed work amounted to $142,000, not including buildings in course of reconstruction June 30, 1913, on which $33,000 already expended. Up to Apr. 1 new construction, moving, and part of maintenance work handled by 5 traveling gangs of carpenters. All American buildings in Gorgona had to be removed and reerected by Sept. 1, 1913, so that 9 new gangs formed to complete work on schedule time.

On June 30, 1913, 23,184 men, women, and children occupying quarters, practically same as during previous year. Of these, 9,173 in gold quarters, 4,295 in European quarters, and 9,716 in West Indian quarters. Over 90 per cent of American and European employees occupy Isthmian Canal Commission quarters, but less than 25 per cent of West Indians take advantage of them. Problem of housing employees properly difficult one. Because of opening up of terminal work congestion, especially in bachelor quarters, in this territory. Necessary to move and reerect a large number of houses for use as quarters. Demolition of old settlements of Balboa and Gorgona complicated situation. In moving Gorgona necessary to care for 200 American families, 600 American bachelors, and several hundred West Indians. Movement began in Mar. and was almost completed at close of year.

Value of material received from U. S. greater than for any preceding year; $13,980,071, not including $2,535,860 paid to McClintic-Marshall Construction Co., or value of local purchases amounting to $2,733,867. Consumption of cement decreased from 1,600,000 barrels, 1912, to 1,200,000 barrels, 1913; total consumption to date, 5,797,910 barrels. During year all cement was purchased in sacks, of which 33,475,408 received and 29,882,968 returned to U. S.; of those returned, 269,775 sacks rejected, or less than 1 per cent returned. Consumption of lumber 27,000,000′ b. m., about the same as preceding year, and total receipts of lumber since inception of work 231,000,000′ b. m. Stock on hand at all storehouses June 30, $3,436,995; decrease of

$284,217 from stock June 30, 1912. Actual reduction greater than net decrease would indicate, as approximately $638,000 worth of material returned to stock by various divisions. Problem of supply especially difficult during year. As work draws to completion considered advisable to keep stock on hand at as low a figure as possible and operate on close margin. This necessitates large number of rush and cable orders, increasing work of supply department on Isthmus and of purchasing agency in U. S. Hoped that spare parts now in stock can be worked off, particularly car, steam shovel, and locomotive repair parts. before completion of work.

Under contract for sale and removal of French scrap, entered into Sept., 1911, 21,730 tons collected from points along line and shipped to storage yard at Cristobal. Price, $215,000. Time allotted for removal of material, 3 years; almost 2 years have elapsed and Isthmian Canal Commission received but $13,473. Contract entered into with Chicago House Wrecking Co. covering American iron and steel scrap already accumulated or that would accumulate during fiscal year. Scrap totaled 12,109 tons. Payment to be made on ship's bill of lading as shipped from Isthmus; the Isthmian Canal Commission received only $18,571, as but 2,466 tons shipped. Sale of scrap screenings removed from buildings netted $6,866 and scrap rope and hose sold to value of $4,693. Approximately $75,000 realized from sale of copper and brass scrap accumulated in operation of Gorgona brass foundry.

Besides regular issues to departments and divisions, sales made to employees, contractors, private individuals, and companies, total aggregating $106,037.77. Value of stock at obsolete storehouse June 30, $431,916, an increase of $70,000 over total on hand at close of previous year. Bids invited for material in obsolete storehouse Feb. 23, 1912; of 24 classes advertised awards made on 6, as either no bids received on other classes or bids below upset price. Under circular issued Feb. 1, 1913, satisfactory bids received on only 4 of 27 classes. These sales demonstrate method of sale of entire equipment and material not satisfactory. Believed that best results would be obtained by placing fair upset price on such material and equipment and selling it when opportunity offers. Board of appraisal appointed to place values on all articles offered for sale. Under this arrangement equipment to value of $32,000 sold and paid for. In addition, $18,670 worth of equipment appraised sold to United Fruit Co. in June, 1913, but delivery not yet been effected.

All purchases on Isthmus aggregated $2,733,867, of which $1,492,322.52 were for coal from Panama R. R., $995,408.92 for crude oil from Union Oil Co., and $223,208.26 for miscellaneous purchases from Panama R. R. Co., leaving $22,672.81 for purchase of miscellaneous supplies from local merchants. Balance used for postage stamps.

Work done for sanitary department, consisting of grass and brush cutting, disposal of night soil and garbage, continued. Grass cut on request from sanitary department. Total cut, 7,356 acres, of which 4,822 acres cut by scythe and 2,534 acres by horse mower. Area covered by sanitary work, 2,980 acres. Cost of sanitary work done by Q. M. department, $125,983.21.

Animal transportation inadequate to meet demands, and 50 mules purchased at a cost of $10,562, reaching Isthmus May 26; scarcely replaced animals condemned or which died. Six horses and 20 mules condemned and destroyed and 5 horses and 4 mules died; total of 35 animals. **P-13,** 53, 57.

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1905. Apr. 1 to June 30, 1905, U. S. funds including sales of material and supplies, water, lighting, commissary supplies, receipts from sanitary patients, rentals of land, taxes, work done, reimbursements, earnings of telegraph lines, etc., $71,640.84. Zone revenues: Postal, internal revenues, court fees, fines, permits, etc., $21,318.45. Total, $92,959.29. **P-05,** 194.

1906 To June 30 and to Sept. 30, 1906, receipts, $103,496,553.45. Disbursements, $25,472,446.90. **P-06,** 118–127.

Recesses. (See Gates; Locks.)

Reclamations.
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Recreation Department. (See Clubhouse and Employees.)

1905. Isthmian Canal Commission convinced social environment of U. S. should be transferred to the Isthmus for American employees. Buildings assigned for churches; schoolhouses building. Houses to be provided for clubs. Reading rooms established. Vessel assigned for free excursions for employees. Free quarters for families of certain employees. **P-05,** 8, 9.

1906. Erection of clubhouses authorized, a few ready; cooperation with Y. M. C. A. in management of club centers planned. Authority given for erection of suitable accommodations for divine service, lodge purposes, etc. Employees solving the problem of entertainment and recreation themselves to a degree. **P-06,** 4.

1907. Four clubhouses completed; under management of Y. M. C. A., subject to an advisory board. "The influences of the clubhouses are excellent." Several religious buildings built. Upper floors of religious service buildings used as lodge rooms, etc. **P-07,** 34.

1908. Lodge and church buildings built. Five bandstands erected. Isthmian Canal Commission band played every Sunday at some point on the line. Clubhouses (4) under care of Y. M. C. A. successful; more recommended. **P-08,** 30.

1909. Type lodge houses erected at Empire and Gatun, band stand at Gatun, and chapel at Ancon. Isthmian Canal Commission clubhouses located at Culebra, Empire, Gorgona, and Cristobal; operated under the Y. M. C. A. Allotment made for new one at Gatun, and for small recreation halls at Corozal and Porto Bello. Question whether additional clubhouses will be built; fixed charges a factor. **P-09,** 30.

1910. New clubhouse erected at Gatun at cost of $21,312.88, and smaller hall at Porto Bello at cost of $4,426.59. These 2 added to 4 clubhouses already constructed at Culebra, Empire, Gorgona, and Cristobal under supervision of Y. M. C. A. Membership largest in June, when it reached 1,643; average monthly membership for year, 1,264. Expenditures from Isthmian Canal Commission funds for clubhouses, $38,812.41. Small recreation hall constructed at Corozal at cost of $3,954.66; since completion, under management of employees themselves. **P-10,** 45, 46.

1911. Seven clubhouses in operation. Small recreation hall at Corozal, operated under employees, enlarged and turned over Jan. 24 to supervision of Y. M. C. A. Additions made to clubhouse buildings at Empire and Cristobal and additional bowling alley installed in each. Additions, including alleys, paid for from Y. M. C. A. funds at cost of $4,762.80. Additional equipment, consisting of phonographs, umbrella racks, library books, bowling and pool equipment, and vibrators for the barber shops added. Average monthly membership for year, 1,947, as against 1,264 for previous year. Smallest membership for any month, 1,712, July, 1910; and largest, 2,121, Jan., 1911. Expenditures from funds for support of clubhouses, $60,488.46, of which $51,193.90 for operation of clubhouses and $9,294.56 for equipment for new clubhouses at Gatun and Corozal. **P-11,** 57, 58.

1912. June 30, 1912, clubhouses in operation at Corozal, Culebra, Empire, Gorgona, Gatun, Cristobal, and Porto Bello, under supervision of Y. M. C. A. Bowling alleys, locker rooms, shower baths, and barber shop added to Corozal clubhouse at cost of $5,000. Average monthly membership for year, 1,944, as against 1,947 for previous year. Smallest membership for any month, 1,784 for Aug., 1911, and largest, 2,092, June, 1912. Expenditures from Isthmian Canal Commission funds for support of clubhouses, $50,565.61. **P-12,** 65, 66.

1913. June 30, 1913, clubhouses in operation at Corozal, Empire, Gorgona, Gatun, and Cristobal in zone, and at Porto Bello, about 20 miles down Atlantic coast. Clubhouse at Culebra removed because of slides and portion of building reerected at rear of administration building annex at cost of about $1,700, paid from clubhouse funds. Bowling alleys, pool and billiard tables, soda fountain, barber shop, and reading room were thus provided in this new location. Entertainments given in second story of schoolhouse. Average monthly membership for year, 2,023, as against 1,944 for previous year. Largest membership for any given month, 2,127, largest since organization. Expenditures from Isthmian Canal Commission funds for support of clubhouses, $49,925.96. **P-13**, 68.

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  Control of Chagres and other streams: Above Bohio a clear mountain stream; entire area never determined; drainage estimated to range from 700 to 875 square miles above Bohio. Observations of the discharge of the Chagres at Gamboa have been maintained from 1882 to the "present" (1906) time. There have been but 6 severe floods in half a century, of short duration. Data sufficient for determination of complete reservoir control of the Chagres floods by a dam at Gamboa. This dam would have control only in case of a sea-level canal, and control and water supply in case of a lock canal. During three-fourths of the time the Chagres and other streams discharge an insignificant amount of clear water. When they are in flood they will bring down some silt, and it is recognized that the maintenance of the navigable channel will require a small amount of dredging. **P-06***, 42.

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Sanitation, Operations.

1904. Preliminary steps taken, Apr , 1904, for organization of health department. Isthmian Canal Commission No. 2 on its first visit to Isthmus, accompanied by Dr. W. C. Gorgas, colonel, U. S. Army; by Dr. John W. Ross, U. S. Navy; by Dr. L. A. La Garde, major, U. S. Army; and an engineer officer of the Army, Capt. (now Maj.) C. E. Gillette, to study health subject. Officers named of the staff which gained distinction in sanitation matters during the American occupation of Cuba. Final organization of the health department perfected Aug., 1904. The department of health, with jurisdiction extending beyond the limits of the Canal Zone into the cities of Colon and Panama and over the waters adjacent thereto, a branch of the government of the zone, and made an administrative department thereof. Four members in the board of health—the chief sanitary officer, the director of hospitals, the chief quarantine officer, and the chief sanitary inspector of the zone. There were found on the Isthmus as a part of it an extensive hospital at Ancon, and several neglected hospital buildings at Colon. Second hospital at Colon operated by the Panama R. R. In addition to caring for these hospitals, emergency hospitals were established, and dispensaries. Employees on the Isthmus entitled to free medical attention, etc. The sanitary inspectors examined properties, pools, etc., and insisted upon the following of sanitary precautions of all kinds. Quarantine service established, and stations opened. Rules and regulations adopted for Colon and Panama, and Republic asked to enforce them. In the 10 months of service succeeding Aug., 1904, about $1,100,000 to be spent. Examination made of methods pursued by the Republic of Panama for the care of the sick, etc. **P-04,** 49.

Health and sanitation: Indifferent at transfer. French company could not compel adjacent communities to clean up. French hospital expenditures lavish. Health of zone good at transfer, and so continued.. Departmental work begun; force put to work improving sanitary condition in zone and adjacent places; plans preparing for water supply and sewage for towns; hospital service improved. Climate not a deadly one. Statistics of health and sanitary service. **P-04,** 86–91.

1905. Results of the sanitary department such that health of the zone assured. Climate no more a handicap than would be U. S. places 50 miles or so from Gulf of Mexico. **P-05,** 120.

Republic of Panama unable to enforce sanitary regulations in cities of Panama and Colon, and assumption of this duty by Isthmian Canal Commission No. 2, **P-05,** 269.

Disposal of night soil, methods, **P-05,** 273.

Cooperation of Isthmian Canal Commission sanitary department and Republic of Panama with regard to hospitals, and care of sick, insane, etc., **P-05,** 339.

1906. Yellow fever abolished. Last case Nov. 11, 1905. Average daily sick rate among employees during 10 months from Jan. 1, 1906, to Oct. 31, 1906, 28 per thousand; death rate, 17½ per thousand among the whites, and nearly 53 per thousand among the blacks. **P-06,** 2.

Sanitation of near-by countries: Outbreaks of communicable diseases in adjacent countries suggest desirability of U. S. making some arrangements for better sanitation. Yellow fever in Ecuador. Government of that place willing to cooperate with U. S. in abolishing it, but notable local opposition to interference of U. S. **P-06,** 22.

Municipal sanitation: Pushed with energy through the year. 50,000 sq. y. paving in Panama. Sewer system practically completed, 55,840′ of piping laid. Water system complete, curb connections being made. Ancon Reservoir in operation; sewer system connected with Ancon. La Boca connected with Rio Grande Reservoir. Corozal and Miraflores connected with Rio Grande Reservoir. At Paraiso, sewer being laid; town supplied with water from Rio Grande. For town of Culebra, reservoir constructed on Mount Zion. Water supply provided for various other points. Dam built across Rio Carabali, impounding approximately 40,000,000 gallons at elevation of 65′ above sea level, for Gorgona. Emergency supply for Colon provided by building temporary reservoir connecting with an old French system. Permanent water system for Colon under way, and sewer system. Water tested; found good; but sterilizing plants, etc., existing or under way. **P-08**, 25.

One of the chief aims of the sanitary brigades the extermination of mosquitoes. Bulk of work against Anopheles species. 2,000,000 sq. y. of ground cleared. Zone covered with network of ditches, some of them being lined with stones. Screening of edifices, etc., insisted upon. Screening reduces cases of malaria from outbreak of 33 per cent to only 4 per cent.

Less fumigation required. Sanitary work at Colon more difficult than at other places in zone and vicinity. Progress made, however, toward converting the lowest, wettest, and dirtiest spot in the Republic of Panama into a safe habitation for American employees. **P-06**, 29.

Sanitation and hygiene of Panama route: Early history of the region, with respect to mortality, etc. Mortality among employees engaged in building the Panama R. R. in 1855 not 150,000 (equaling the number of crossties), as so often reported; chief engineer of the road asserted repeatedly that the total number of persons engaged on the road never exceeded 7,000 at any one time, and that the laborers and workmen who died in the 5 years of building did not exceed 1,200 in all. Prior to coming of Americans the sanitary methods employed were those known to be most efficacious among scientists. Vital statistics furnished by Col. Gorgas. The records show that it is not only possible but feasible to banish yellow fever from the Isthmus and to maintain the whole force of employees in a good state of health. Sickness on the Suez Canal conquered by killing the dangerous mosquitoes. **P-06***, 18.

1907. Sanitation separated from department of government, in which it was a division, and created a new department, **P-07**, 31.

Success dependent on its ability to guard against the malarial mosquito; accomplished by draining and clearing the ground in neighborhoods, and proper quartering. 16,000,000 sq. y. brush cut; 1,000,000 sq. y. swamp lands filled and drained; 30,000,000 sq. y. grass burned; 217,000 linear feet ditches dug; 50,000′ tile ditches laid; cemented, 50,000 linear feet. Miscellaneous work of every description. Considerable sanitation work done in cities of Panama and Colon. "Too much credit can not be given the department for the elimination of yellow fever." No cases originating in the zone; 1 case got in. Nearly 50 cases of smallpox developed; instant fumigation. 3,000 persons exposed to yellow fever or smallpox quarantined. Largest division of the department to do with the care of the sick, requiring for maintenance thereof more than half the sums appropriated for sanitation. Attention and medicine free to Isthmian Canal Commission and Panama R. R. employees. To families of employees, a charge made. Average daily sick for year, 916. Statistics show marked improvement in health conditions. Lepers removed to colony at Palo Seco. Five new hospital buildings built in zone; additions made to others. Hospital beds increased from 1,252 to 1,845; increase of emergency cots by 587. Quarters provided for insane. Culebra and Naos Islands to be fitted for quarantine quarters. **P-07**, 31-32.

1908. Duties: General sanitary work of zone (as well as of cities of Colon and Panama); also the care of the sick and the maintenance of the hospitals.

Organization: Changes proposed for economy, removal of friction, and a more definite fixing of responsibility. In addition to the work of policing and grass cutting in vicinity of quarters, the Q. M.'s gangs to be charged with collection of garbage, removal of night soil, cutting of brush and grass for sanitary department. Proposed, also, that tiling and drainage be done by construction forces of engineering department. Proposed to make these transfers Sept. 1, 1908. Sanitary department to indicate what work shall be done so far as it relates to sanitation.

Health: Conditions improved. Average of 43,057 names on pay roll; death rate, 18.32 per thousand. Whites, death rate, 15.34. Blacks, death rate, 19.48; less than half that of the previous year. Better food the ascribed reason for the lowered death rate among the blacks.

Hospitals: 27,523 admitted; 29 deaths; 1,138 undergoing treatment at end of year. Two hospitals care for the sick (Ancon and Colon). 20 sick camps. Old buildings at Culebra converted into hospital for penitentiary patients. **P-08**, 27, 28, 29.

1909. Duties: Supervision of the sanitary department extends over the zone and the terminal cities.

City of Panama: Agreement with Republic of Panama, Sept. 1, 1907, by which street cleaning, etc., to be performed by the city, the U. S. assisting by paying $10,000, or about one-fourth of the cost of the work.

City of Colon: Agreement with Republic of Panama, July 1, 1908, provided for the payment by the former of $4,735.19 on account of street cleaning and garbage removal within period from July 1 to Dec. 31, 1908. Beginning Jan. 1, 1909, and continuing from year to year until the contract be canceled by either party upon notice of not less than 30 days before the expiration of an annual period, Panama agrees to pay one-half the cost of such work for the city of Colon.

Transfer of operations: Work in the zone for the first 2 months similar to that of the previous year. Under the general reorganization scheme, actual physical work, except oiling, transferred to the local engineering departments along the line, the sanitary department exercising general supervision, etc.

Hospitals: Further consolidation of hospitals made; sick concentrated at Ancon; Colon Hospital reduced to 150 beds. Chronic ward established at Colon, for transferred men who by reason of disability must continue to be a charge on the Isthmian Canal Commission as long as they are on the Isthmus.

Health: Improvement over previous year. 46,194 admissions to hospitals and sick camps, and in quarters; being 23.49 out of every 1,000 on the rolls, as against 23.85 for the preceding year. Deaths, 530; rate, 11.97 per thousand, as against 18.32 for the preceding year.

Quarantine: No plague or yellow fever originated on the Isthmus; one case of the plague developed on a ship at Balboa; death ensued at quarantine station. Ship had been required number of days in quarantine from infected port. **P-09,** 29, 30.

1910. Work of department embraces sanitary work in cities of Colon and Panama and, except oiling, designates sanitary work to be done in zone to accomplish desired ends, exercising supervision necessary to see work satisfactorily performed; in addition, department has charge of hospitals and quarantine. In charge of Col. W. C. Gorgas, Medical Corps, U. S. Army, chief sanitary officer. Work in terminal cities consists of cutting grass and brush, oiling pools, and constructing and maintaining ditches for drainage purposes, removal of garbage and night soil, fumigation and street cleaning. On account of juxtaposition of Cristobal and Mount Hope to Colon, these included in Colon area, and for same reason, Ancon incorporated with Panama.

In zone, Q. M. department expended under direction of sanitary department $127,923.28 in grass and brush cutting in and about Isthmian Canal Commission settlements, and $47,009.87 for removal of night soil and garbage. Expended for removal of garbage and night soil in native settlements, $25,414.51. In maintenance of existing ditches and construction of new ones for drainage, construction division expended $88,545.83; new work done in accordance with plans prepared by sanitary department. Total expended for oil, and labor in distribution, $42,686.58.

Health conditions on Isthmus reported by chief sanitary officer as improvement over preceding year. Admissions to hospitals and sick camps, including sick in quarters, 26,539. Daily average of sick, 23.01 out of every 1,000 employed, as against 23.49 for preceding year. Deaths among employees, 548; equivalent to average of 10.84 per 1,000.

In addition to deaths among Americans, which aggregated 76, 39 deported as physically unfit, 10 recommended for extended leave without pay for same reasons, and 6 given extended leave with pay in U. S. on account of injuries.

No case of plague or yellow fever originated on the Isthmus. One death from yellow fever, a young Englishman, at Ancon Hospital, Jan. 24, 1910. Deceased passed quarantine at Colon Jan. 6 and taken ill Jan. 8. Case diagnosed yellow fever Jan. 22. On Jan. 24 thorough fumigation undertaken of building in which deceased lived while in Panama, as well as factory in which he worked. **P-10,** 44, 45.

1911. In the zone the Q. M. department expended in and about Isthmian Canal Commission settlements $114,725.98 for grass and brush cutting, and $42,184.35 for removal of night soil and garbage. Expended for removal of garbage and night soil in native settlements, $22,615.03. In maintenance of existing ditches and construction of new ones for drainage purposes construction divisions expended $81,407.93; new work done in accordance with plans prepared by sanitary department. Sanitary department expended $11,708.08 for oil and $16,756.17 for distribution, $16,711.85 for larvacide, and $13,489.74 for distribution, or total of $58,665.84; in addition, $99,241.19 expended for sanitary work in terminal cities.

Admissions to hospitals and sick camps, including sick in quarters, 53,534; daily average of sick, 24.77 out of every 1,000 employed, as against 23.01 for 1909–10, and 23.49 for 1908–9, on the basis that total number employed during the years mentioned were 49,129, 50,535, and 44,261, respectively; total number of deaths among employees, 557, of which 33 were Americans, 96 white employees of other nationalities, and 428 blacks; deaths from violence among all employees, 178, as against 174 for preceding year; in addition to deaths reported, 134 deportations made—104 for disease and 30 for injuries. **P-11,** 56, 57.

1912. Work in Panama consisted in cleaning 398 miles of ditches, digging 2.5 miles of ditches, and clearing 118 acres of weeds and grass, in addition to oiling, disinfecting, and fumigating. In Colōn district, from same source, 112.5 miles ditches maintained, 8 miles ditches constructed, and 217 acres cleared of vegetation, in addition to oiling, disinfecting, fumigating, etc.

Impression general elsewhere than on Isthmus that sanitary work, in the way of clearing land, extends over entire zone; of 278,848 acres comprised within zone limits less than 1,200 acres kept cleared for sanitary purposes and on sanitary requests, outside of military reservations, where work is done by troops. In addition, clearing done for construction purposes, but almost entire zone in original condition as regards brush and jungle.

Expense for sanitary work in zone and in Panama and Colon, $596,608.73, of which

$67,968.19 for sanitation proper in two cities, $409,205.84 for sanitation in zone, $18,672.50 for removal of garbage and street cleaning in two cities, and $100,760.20 for removal of garbage and street cleaning in zone. Of amount expended for sanitation proper in zone, construction divisions expended $89,725.17, principally in maintenance of existing ditches and construction of new ones for drainage purposes; Q. M. department, $93,876.26 for grass and brush cutting; sanitary department used 719,835 gallons of oil, costing, $18,862.81, and 124,718 gallons of larvacide, costing $23,751.64; labor expense for distributing, $18,820.05 and $17,514.06, respectively. All work performed by construction divisions and Q. M. department done under direction of sanitary department, new ditching being done in accordance with plans prepared by that department after consultation with divisions interested. Removal of garbage and night soil in zone done by Q. M. department.

Admissions to hospitals and sick camps and sick in quarters, 48,307; daily average sick, 22.91 out of every 1,000 employees, as against 24.77 for 1910–11 and 23.01 for 1909–10 on basis that total numbers employed during years mentioned were 50,008, 49,129, and 50,535, respectively; deaths among employees, 508, of which 35 Americans, 79 white employees of other nationalities, and 394 blacks; deaths from violence among all employees, 154, as against 178 for preceding year. 193 deportations made—141 for disease and 52 for injuries. **P-12,** 64–65.

1913. Work in Panama consisted in cleaning 220 miles ditches, digging 1.2 miles ditches, and clearing 114 acres of weeds and grass, in addition to filling and cleaning cesspools and wells, oiling, disinfecting, and fumigating. In Colon district, from same source, 72 miles ditches maintained, 77 miles ditches constructed, and 29 acres cleared of vegetation, in addition to oiling, disinfecting, and fumigating.

Expense for sanitary work in zone and in cities of Panama and Colon, $510,529.17, of which $62,955.06 for sanitation proper in the two cities, $371,844.90 for sanitation proper in zone, $10,627.60 for removal of garbage and street cleaning in the two cities, and $65,101.61 for removal of garbage and street cleaning in zone. Of amount expended for sanitation in zone, construction divisions expended $91,877.98, principally in maintenance of existing ditches and construction of new ones for drainage purposes; Q. M. department, $50,533.13 for grass and brush cutting. Sanitary department used in zone 674,662 gallons of oil, costing $17,669.69, and 120,992 gallons of larvacide, costing $21,759.96; labor expense for distributing, $21,320.39 and $19,567.39, respectively. All work by construction divisions and Q. M. department done under direction of sanitary department. Removal of garbage and night soil in zone done by Q. M. department.

Admissions to hospitals and sick camps during year, including sick in quarters, 33,779; daily average number of employees sick, 19.04 out of every 1,000, as against 22.91 for 1911–12 and 24.77 for 1910–11—this on basis that total numbers employed during years mentioned were 54,000, 50,008, and 49,129, respectively. Deaths among employees, 483, of which 36 Americans, 58 white employees of other nationalities, and 389 blacks. Deaths from violence among all employees, 164, as against 154 for preceding year. 183 deportations made—134 for disease and 49 on account of injuries. **P-13,** 67, 68.

1914. Sanitation of zone placed in charge of health department, under Lt. Col. C. F. Mason, U. S. Army, as chief health officer, and department charged with care of sick and injured of zone, prevention of disease in zone and cities of Panama and Colon, street cleaning and garbage removal in latter cities, and all matters relating to quarantine. Matters relating to charity added. Administration divided into 3 divisions—hospitals and charities, sanitary division, and quarantine division.

Division of hospitals and charities: Maintains hospitals at Ancon and Colon and assists in maintaining Santo Tomas Hospital in city of Panama. Maintains institutions for care of insane and lepers of both zone and Republic of Panama and for employees permanently disabled through injury. Provides dispensary in each district into which zone divided. District physicians attend sick, send patients to hospital, perform vaccinations, make inspections of schools, hotels, restaurants, canal quarters, etc., and report births and deaths.

Sanitary division: Has 3 sections—health office of Panama, health office of Colon, and zone section. In zone section each district has sanitary inspector, with necessary foremen and laborers, all under direct charge of general inspector; inspectors keep close watch upon their districts, with view of preventing and controlling conditions which might give rise to disease, and especially endeavor to prevent breeding of disease-carrying mosquitoes and flies. They supervise construction and maintenance of drainage ditches, and cutting of grass and brush, oil pools and edges of large bodies of water, supervise removal of garbage and night soil, trap and catch mosquitoes in Panama Canal quarters, disinfect pit and other closets, and disinfect buildings for contagious diseases. Charged with enforcement of sanitary regulations, and have authority to personally make arrests when they have witnessed violation of regulations. Issue burial permits, make interments, and care for cemeteries. They keep charts of prevalence of malaria, and immediately investigate and take action upon any increase

therein. Work by health officers of Panama and Colon that by health officers everywhere. In addition, they have charge of street cleaning, garbage removal, grass and brush cutting, oiling of pools, fumigation, disinfection, etc. Duties in enforcing sanitary rules and regulations extensive, and include vaccinations, control of infectious and contagious diseases, special precautions against quarantinable diseases prevailing in Tropics, control of burials, inspection of slaughterhouses and of cattle for slaughter, inspection of markets, enforcement of pure-food regulations, inspection of bakeries and dairies, examination of milk, inspection of stables, bottling works, and barber shops. Large part of their time given up to enforcement of sanitary building regulations, especially with reference to rat-proofing as protection against plague.

Quarantine division: In direct charge of chief quarantine officer, and maintains large establishments at each end of canal—one for Panama and Balboa and the others for Colon and Cristobal. Maintains quarantine officer at Bocas del Toro. Division, already large, expected to increase greatly in proportions when canal is open to traffic; will include new features in arrangement for passage of ships through canal in quarantine. Ground on Balboa dump, fronting upon and adjoining Fort Amador on south and radio station on east, assigned as permanent site for Panama quarantine station. Board appointed to select site for permanent quarantine station at Cristobal. **P-14,** 64, 65.

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1906. Although school system was authorized in 1904, but little done until Dec., 1905. On Jan. 2, 1906, first free public school under the Canal Zone government opened at Corozal. At first 2 sets of schools, but on Feb. 1, 1906, municipal schools made a part of the zone system. Supervision of schools transferred to chief of bureau of municipalities, which was created May 1, 1906. This made for greater progress. May 1, 1906, 18 schools, 21 teachers, 840 pupils; June 1, 22 schools, 1,088 pupils; Sept. 30, term ended with 30 schools, 1,796 pupils. Sept. 30, 12 American teachers, 1 Panaman, and 19 Jamaican (colored). Of the 30 schools, 4 were for white children; other mixed. Of the 1,800 pupils, about 10 per cent only American and white. Mar. 3, first convention of teachers held. School system essentially American, methods, books, songs, flag, etc. Schools welcomed by zone people. Expenses paid from funds of zone; not from canal-construction funds. **P-06,** 39.

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Sixth Division. (See Pacific Division; see No. 256, p. 2368 of this Index.)
1913. On abolition of Pacific division, dredging and procuring of sand from Chame organized into separate district reporting to chief engineer. Decided, Feb., 1913, to flood Culebra Cut, Oct., 1913, by removal of dike at Gamboa. Estimated 350,000 c. y. had to be removed from lake section north of Gamboa, and that this could be done most economically by dredging; Cucaracha slide, largely clay and small spalls, could not be removed economically by steam shovels after heavy rains set in, but could be handled efficiently by suction dredges; conclusion reached that subsequent to admission of water into cut work remaining could be handled most expeditiously and economically by dredging fleet. To get fleet in condition to handle work by that time and to take care of what remained at entrances, it naturally followed that best results could be accomplished by concentrating dredging under one head; May 1 this was done, and division organized with W. G. Comber as resident engineer.
Fleet available on Atlantic side, seagoing dredge "Caribbean," 5-yard dipper dredges "Chagres" and "Mindi," French ladder dredges "No. 1" and "No. 5," and 5 pipe-line suction dredges. One of the pipe-line dredges, after finishing hydraulic fill in dam, overhauled and laid up in Gatun Lake until water in lake was of sufficient depth for it to begin operations north of Gamboa, other dredges operated within prism north of about milepost 6, covering about 5 miles of channel, removing therefrom during year 5,730,379 c. y. earth and 753,029 c. y. rock. July 1, 1913, there remained to be removed from prism 1,837,000 c. y. earth and 99,600 c. y. rock. Of rock excavated from channel, 680,176 c. y. dumped in vicinity of west breakwater, making total to date furnished by dredges for this purpose 1,810,108 c. y. Of this, 651,000 c. y. dumped within breakwater section. In removal of rock from channel drill boat "Terrier" drilled 43,062 linear feet in prism, breaking 394,526 c. y. material. At end of fiscal year 40′ of water could be carried through approximately first 1½ miles of channel, 35′ through next 5 miles, and between this and locks depth varied from 10′ to 30′. Siltage in prism for year, 2,084,000 c. y.
In addition to work in channel and in excavation for wing walls and north center approach pier of locks already reported, dredges operated in vicinity of new docks at Cristobal, of dry dock at same locality, of mouth of Mindi in French canal, and of Margarita Island. In approach channel to new docks at Cristobal 665,018 c. y. earth removed, and from slip between Piers 16 and 17 on new terminals 155,693 c. y. earth and 189,284 c. y. coral rock dredged. "Terrier" drilled 4,511′ at site of permanent bridge across French canal for railroad connection with coaling plant, and 34,448 c. y. material broken up by blasting. From dry dock basin, to provide mooring berth for suction dredge "Caribbean," 3,851 c. y. removed, from French canal at Mindi 295,535 c. y. earth excavated, and 100,957 c. y. dredged from Margarita Bay and used for parapet and swamp fill in that locality. Site cleared for proposed coaling station on Telfer Island.
At Pacific entrance there were employed seagoing suction dredge "Culebra," 5-yard dipper dredge "Cardenas," 4 French ladder dredges, seagoing ladder dredge "Corozal," and 1 pipe-line suction dredge. Pipe-line suction dredge transferred from Atlantic end when it had completed its work on hydraulic fill for Gatun Dam; dismantled, hull cut in sections and moved over by railroad to Balboa, and after reerection put in commission Nov. 16, 1912. For remainder of year employed principally in dredging from site of proposed inner harbor and terminal basin at Balboa.
Total removed from prism during year, 4,321,956 c. y., of which 1,047,929 c. y. rock. At close of fiscal year there remained to be removed from prism 1,847,774 c. y. earth and 1,600,000 c. y. rock. Of total rock removed from prism, 121,161 c. y. drilled and blasted by drill barge "Teredo" and 65,953 c. y. broken by rock breaker "Vulcan." Remainder includes rock broken by Star drill operations in previous years and material which could be handled by dredges without drilling and blasting.

Auxiliary dredging outside of prism, 1,457,342 c. y., of which 3,695 c. y. rock. Of this, 1,453,647 c. y. earth and 3,695 c. y. rock removed from inner harbor and terminal basin site. At close of year there remained to be removed from inner harbor and terminal basin 6,363,240 c. y. earth and 372,062 c. y. rock. Clearing of this site extended over area of 1,050,988 sq. feet and consisted of cutting brush and trees and blasting stumps. Orange-peel dredge excavated 7,800′ of diversion channel, for draining swamp lands at Balboa to be reclaimed by hydraulic filling.

During year 445,658 c. y. sand procured from Chame by dredging and transferred to sand bins at Balboa. Of this, 435,758 c. y. transferred to stock piles for use in concrete construction for the fifth division. Sand bins had total length of 260′ and were provided with 3 rapid unloading cranes until early in May, 1913, when, because site of bins encroached upon terminal work, 1 unloader removed and bins shortened to 175′. Proposed to reerect crane at Gamboa for use in procuring gravel from Chagres River.

Arrangements made by which 2 suction dredges and "Corozal" will be moved into Culebra Cut soon as locks will permit and depth of water is sufficient, with view to attacking Cucaracha slide. Suction dredges will remove clay and, assisted by relay pumps located on 95′ level on west bank, will discharge into Rio Grande Valley. "Corozal" will handle heavier material, depositing it in low areas of Gatun Lake. Anticipating necessity for completing cut by dredges, contract entered into Jan. 16, 1913, for construction and delivery at Colon of 2 dipper dredges of largest and most powerful type. To be equipped with 15-yard buckets or dippers for dredging soft material and 10-yard buckets for rock. Deliveries expected at tidewater in U. S., ready for shipment to Isthmus, Dec. 1, 1913, and Jan. 1, 1914. To serve these dredges 6 dump scows of 1,000 c. y. capacity contracted for June 13, 1913; 2 to be delivered on or before Dec. 12, 1913, 2 on or before Jan. 27, 1914, and 2 on or before Mar. 13, 1914. **P-13,** 35–38.

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Canal to be constructed of sufficient capacity and depth as shall afford convenient passage for vessels of the largest tonnage and greatest draft "now in use," and such as may be "reasonably anticipated." Necessary locks to be supplied, and terminal harbors. Measures for defense to be taken. President authorized to employ whoever necessary, etc.
Failing negotiations with Panama Canal Company, etc., canal by Nicaragua route authorized. Details.
$10,000,000 appropriated. Contracts authorized. Additional appropriation may be made, not to exceed in aggregate $135,000,000 additional by Panama route, or $180,000,000 by Nicaragua route.
Special arrangements may be made with Colombia, Nicaragua, and Costa Rica for use of canal and harbors for vessels owned by those states, etc.
Creation of Isthmian Canal Commission of 7 members, appointed by the President, etc. One to be named as chairman. Four learned and skilled in engineering, 1 an officer of the U. S. Army, 1 an officer of the U. S. Navy. Compensation of the Commission to be named by the President until otherwise fixed by Congress. Employment of engineers, etc., through the Commission. Commission subject to the direction and control of the President, reporting to him.
Secretary of the Treasury authorized to borrow on credit of the U. S. $130,000,000.

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Subsistence Department. (See Nos. 224, 246, pp. 2366, 2367 of this Index.)

1908-9. Organization: Commissary of Panama R. R. transferred, July 16, 1908, to charge of subsistence officer of Isthmian Canal Commission, and managed in connection with hotels, messes, kitchens, etc.

Sales: $4,841,647.09. Commissary of no expense to Isthmian Canal Commission; operated at a profit to Panama R. R., surcharges being added to stuffs handled sufficient to pay off expense incurred by railroad company for the erection of buildings and various plants, and to cover freight and handling charges along the line.

New buildings: New commissary buildings constructed by Isthmian Canal Commission at Gatun and Porto Bello.

Hotels, messes, etc.: In addition to Hotel Tivoli, there are 17 hotels, 19 messes, 21 kitchens, providing food for 7,700 people. Hotel Tivoli shows profit, line hotels a loss, messes and kitchens a profit. Subsistence feature of Isthmian Canal Commission self-supporting. **P-09**, 24.

1910. Department charged with operation of Hotel Tivoli, 18 Isthmian Canal Commission hotels, 19 European laborers' messes, and 20 common laborers' kitchens; under charge of Maj. E. T. Wilson, subsistence officer.

Hotel added and one kitchen dropped. Supplies procured from commissary, belonging to Panama R. R., operated by subsistence officer, who is also commissary for Panama R. R.

Hotel Tivoli operated at profit of $4,574.23. Meals served at line hotels, 2,176,451; price per meal, 30 cents. Cost for supplies per meal, 24.87 cents, and expense in preparing and serving, 6.23 cents. Total increase of $43,964.31 in cost of the food supplies to line hotels during the year, or of 1.33 cents per meal. Expense in preparation and serving decreased 0.69 cent over preceding year. Total rations furnished European messes, 1,092,487, at cost of 30.18 cents per ration for food and 6.60 cents per ration for expense. Rations served in laborers' kitchens, 781,746, at cost of 22.66 cents for food and 4.63 cents for expense. Total revenue from the line hotels, messes, and kitchens, $1,350,658.05; decrease of $168,620.08 over previous year. **P-10**, 38, 39.

1911. At end of fiscal year department operating Tivoli Hotel, 19 line hotels, 3 night restaurants, 16 European laborers' messes, and 14 common laborers' kitchens; an increase of 1 hotel and decrease of 3 messes and 4 kitchens. Total meals served by hotels, 2,216,740; increase of 40,289 over previous year. Cost of supplies per meal, 25.44 cents, or 0.57 cent more than during previous year; and expense preparing and serving meals 0.62 cent less, or 5.61 cents; resulting in decrease in total cost per meal of 0.05 cent. Total rations served European laborers' messes, 1,054,545, or 37,942 less than last year. Cost of supplies per ration increased 0.16 cent, but cost of service decreased 0.72 cent, making decrease in total cost of ration 0.56 cent, or cost for year of 36.22 cents. Total rations served in laborers' kitchens, 444,503; falling off of 337,243 over previous year. Cost of supplies per ration decreased 0.63 cent and cost of service decreased 0.60 cent, making total cost of ration 26.06 cents.

Revenue for the year from line hotels, restaurants, messes, and kitchens, $1,254,262.40; decrease of $96,395.65. Supplies consumed decreased $57,660.17 and total cost of service decreased $37,980.50, giving total cost of operations of $1,221,469.29. As result of operations, line hotels and restaurants showed loss of $20,905.44, European messes showed profit of $39,236.63, and common laborers' kitchens showed profit of $14,461.95.

On Nov. 1, 1910, room rates at Tivoli Hotel reduced approximately 10 per cent; hotel operated at a profit of $26,427.05. In addition to repairing equipment and replacing such minor dining room and kitchen equipment as necessary, new furniture and linen amounting to $7,000 purchased to replace such as no longer serviceable. **P-11**, 44, 45.

1912. June 30, 1912, department operating 19 line hotels, 3 night restaurants, 18 European laborers' messes, and 18 common laborers' kitchens—increase of 2 messes and 4 kitchens. Hotel and kitchen at Nombre de Dios and hotel at Tabernilla closed because of completion of work. One of two messes at Bas Obispo closed. Hotels, messes, and kitchens opened at Naos Island and Margarita Island, mess and kitchen at Cerro, and kitchens at Rio Grande and Paraiso. Revenue from line hotels, restaurants, messes, and kitchens, $1,263,869.81, an increase of $9,607.41. Total cost, $1,226,352.16; increase of $4,882.90. Profit, $37,517.65; increase of $4,724.51. Total meals in line hotels, 2,075,335, 6.38 per cent less; total rations in European laborers' messes, 1,108,175, 5.09 per cent more; total rations in common laborers' kitchens, 584,457, 31.49 per cent more. Expenditures in salaries and wages for line hotels, restaurants, messes, and kitchens, $162,006.78; saving of $10,022.74. As result of year's operations, line hotels and restaurants showed loss of $12,085.37, European laborers' messes showed profit of $38,455.78, and common laborers' kitchens showed profit of $11,147.24.

Accommodations of Tivoli Hotel increased by building new wing, increasing number of rooms opening on private baths from 28 to 90. New furniture and other equipment to value of $10,000 purchased, greater part of equipment being for new rooms. Hotel operated at profit of $53,652.36. **P-12**, 53, 54.

1913. June 30, 1913, department operating Tivoli Hotel, 17 line hotels, 3 night restaurants, 15 European laborers' messes, and 16 common laborers' kitchens—decrease of 2 hotels, 3 messes, and 2 kitchens. Hotel

at Balboa closed and consolidated with one at East Balboa. Hotel near spillway at Gatun closed Mar. 31, and messes at Cerro, Haut Obispo, Gatun (No. 68), and Naos Island closed, and one at Bas Obispo opened. New kitchen opened at Bas Obispo, while those at Ancon, Cerro, and Haut Obispo closed. Revenue from line hotels, restaurants, messes, and kitchens, $1,235,077.84, decrease of $28,791.97; while cost of operations was $1,205, 800.76, decrease of $20,551.40; making profit $29,277.08, decrease of $8,240.57. Meals served in line hotels, 2,340,644, an increase of 265,309. Rations served in European laborers' messes, 935,516, or 172,659 less. Rations served in common laborers' kitchens, 461,456; decrease of 123,001. Net expenses for salaries and wages, $166,398.65; increase of $4,391.88. As result of year's operations, line hotels and restaurants showed loss of $3,837.71, increase of $8,247.66; European laborers' messes showed profit of $26,845.24, decrease of $11,610.54; and common laborers' kitchens showed profit of $6,289.55, decrease of $4,877.69.

Laundry installed in Tivoli Hotel to handle guests' work opened Dec., 1912. Hotel operated at profit of $76,256.55. **P-13,** 57, 58.

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Suction Dredge. (See Dredge, Suction.)

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Accounting for, **P-08,** 226.
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Supplies, Material and (Department).
1914. Organized Apr. 1, 1914, by combining Q. M. and subsistence departments under old organization, in charge of Capt. R. E. Wood, U. S. Army, as chief Q. M. Has charge of recruitment of labor; construction and repair of buildings; care, furnishing, and assignment of quarters; distributing fuel, commissary supplies, and distilled water; operation of hotels, messes, and kitchens; requisitioning for supplies, together with receipt and distribution of them; cutting of grass and disposal of night soil and garbage, as prescribed by the health department.

During year work of department more arduous than that of any other on Isthmus, by reason of frequent changes in organization due to consolidation of the work, construction of new buildings, elimination of old towns and transfer to new localities.

Force employed on canal dropped steadily, being 29,673, June 30, 1914, as compared with 43,350 at close of previous year. Large emigration, and for first time since work started excess of departures over arrivals of about 15,000. Free transportation furnished 1,361 Americans, 1,173 West Indians, and 1,615 Europeans. Character of force radically changed, due to completion of dry excavation and large increase in building force for construction of quarters, offices, etc. Shop forces made two transfers, one from Gorgona to Empire and then from Empire to Balboa. Dredging forces shifted from terminals at Balboa and Cristobal to Paraiso. Transportation men transferred from Las Cascadas and Empire to Balboa. These changes made necessary by waters of lake drowning out Gorgona where shops were formerly located, by concentration of dredging fleet in Culebra Cut, and by abandonment of Las Cascadas that it might be available for the military. At close of fiscal year there were 17,938 men, women, and children in canal quarters, as compared with 23,184 previous year. Greatest percentage of decrease among American and European employees.

A new town, La Boca, erected on Balboa dumps south of Sosa Hill for silver employees that will eventually be required for permanent organization. Houses which had to be abandoned or moved transferred and reerected at La Boca and converted into family quarters, and apartments rented. Fifty-two buildings, taken from Gorgona, Bas Obispo, Las Cascadas, Diablo, Empire, Culebra, Porto Bello, Gatun, Pedro Miguel, and Ancon Hospital, moved and reerected at La Boca. Structures accommodate 413 families. Cost varied from $111 to $520 per apartment and rents range from $3

to $9 per month. Range closets, cook sheds, washhouses, and bathhouses for bachelor and married employees erected at La Boca. Besides settlement at La Boca, silver quarters at Paraiso, Cristobal, and Gatun thoroughly overhauled, repaired, and rented. At close of year 153 houses, with 736 apartments and rooms, rented to employees on silver roll, monthly amount realized being $3,736.

On June 30, 1914, 2,535 buildings in canal settlement—117 belonged to Panama R. R., 19 to Army, Navy, and Marine Corps, leaving 2,399 belonging to Panama Canal. Of these, 567 French buildings, remaining of total of 2,148 turned over by French company 1904. 136 buildings demolished and 107 sold, practically all French buildings. Raising of lake necessitated removal, demolition, and sale of all buildings at Gorgona and Matachin and most of buildings in labor camps at Chagres and Miraflores, and slides caused demolition and removal of some buildings at Culebra. Of 175 buildings taken down, 153 reerected and 22 in course of erection. Work in connection with erection of buildings for Darien radio station for Navy done by supply department. Permanent buildings constructed consisted of hydroelectric station at Gatun, substations at Gatun, Cristobal, Miraflores, and Balboa, commissary warehouse at Cristobal, the administration building at Balboa, permanent family quarters of concrete blocks (28 four-family and 9 two-family), shops office building, commissary building at Balboa, and commissary building at Ancon. Total expended for these buildings, exclusive of those for commissary, to close of fiscal year, $1,943,430.05.

Policy continued of limiting stock of material and supplies, which necessitated placing of frequent orders. Material received, $11,116,395.10; local purchases, $2,293,144.66. Of local purchases, coal aggregated $929,-176.57; oil, $863,206.66; and tools from the McClintic-Marshall Construction Co., $40,000. Decrease of 130,000 tons of cement, but large increase in lumber purchased. Changed conditions of work necessitated closing down of storehouses at various localities and concentration of material at terminals. Gorgona storehouse closed Aug. 15, 1913; Miraflores storehouse Nov. 1, 1913; Pedro Miguel storehouse Sept. 15, 1913; Toro Point storehouse May 1, 1914; Porto Bello storehouse May 15, 1914; and Ancon storehouse June 30, 1914. Storehouse opened at Paraiso Dec. 1, 1913; cement shed erected for storage at Corozal, and new buildings of Balboa storehouse opened Feb., 1914. Mount Hope depot invoiced material to value of $7,093,963.28, as compared with $10,580,623 during previous year. Stock on hand at Balboa, June 30, 1914, $1,098,143.49.

30,000 tons of rail and scrap handled at scrap yard at Mount Hope. Exclusive of contracts with Chicago House Wrecking Co., under which practically no shipments were made during year, approximately $80,000 worth of scrap sold. In addition, scrap on hand at Mount Hope valued at about $300,000 based on market prices. Expenses of scrap operations proper, $25,000. Unloaders, steam shovels, locomotives, spreaders, pile drivers, and track shifters no longer needed for work prepared for storage, at cost of $14,222.84; this expenditure necessary to secure highest possible prices for material.

June 30, 1914, department operating Hotel Tivoli, Hotel Aspinwall, 12 line hotels, and 10 laborers' messes, decrease of 4 hotels and 5 messes. Hotels at Porto Bello, Gorgona, Dump No. 6, Bas Obispo, Las Cascadas, and Miraflores closed. Mess at Ancon for gold employees and Hotel Aspinwall at Taboga Island opened. Messes at Dump No. 6, Bas Obispo, Culebra, Gorgona, Miraflores, and Porto Bello closed, and common laborers' kitchen at Naos Island converted into laborers' mess. Revenue from line hotels, restaurants, and messes, $1,032,189.51, decrease of $202,888.33; while cost of operations was $1,021,856.92, decrease of $183,942.84; making profit $10,332.59, decrease of $18,-944.49. Meals served in line hotels, 2,131,912; decrease of 208,732. Immediately after July 1, 1913, European laborers' messes and common laborers' kitchens combined and called laborers' messes. Rations served in these messes, 950,994; total rations served in both messes and kitchens during previous year, 1,396,972. Salaries and wages, $133,-638.81, as compared with $166,398.65 for previous year. Line hotels and restaurants showed loss of $18,366.18, as compared with loss of $3,837.71 during previous year. Laborers' messes show a profit of $28,698.77, against combined profit of $33,114.79 on messes and kitchens during previous year.

During last fiscal year demand for wagon transportation heavier than since 1904; necessary to purchase 100 new mules. As a result of necessary town-site work, hauling material for new buildings and those transferred, and collection of garbage in city of Panama, which was transferred to health department during year, all U. S. animals worked to limit. This overwork and the fact that all mules, except those purchased during last 15 months, averaged over 7 years' service on Isthmus, resulted in death of 50 animals, considerably heavier loss than during previous year. **P-14,** 46-50.

Surge.

On locking, Pedro Miguel, in Culebra Cut, **P-14,** pl. 112.

Surveys. (See Geology; see Nos. 20-22, 136, 244, pp. 2361, 2363, 2367 of this Index.)

Alternative line, Gatun to Bohio, **P-04,** 41.

Atlantic division, **P-09,** 59; **P-10,** 117; **P-11,** 108; **P-12,** 122.

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Chagres River, **P-09,** 196; **P-10,** 297.
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Dredging division, **P-14,** 241.
Dredging division, La Boca, **P-07,** 51.
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Upper San Juan to headwaters of the Indio, **P-99,** 349-351.

Surveys, Operations.
1905. Tiger Hill: Surveys for cut-off in route shows change to this location would not be advantageous, **P-05,** 12.
Chagres River surveys: Topography taken of line of proposed Gatuncillo Tunnel and Dique open cut. 67 miles of transit and 120 miles of compass and level lines run and much other engineering work of a related character. **P-05,** 116.
1906. Chagres River division: Extends from Bas Obispo to Bohio. Surveys mainly during the year. "* * * It should be borne in mind that every foot of every line run has been cut out through a dense tropical jungle, and during the rainy season, which continues during the greater part of the year, these surveyors are working in water from ankle to waist deep and are subsisted and quartered in temporary camps. Undoubtedly the engineers * * * are laboring under more adverse and uncomfortable conditions than any other class of employees on the Isthmus." **P-06,** 86.
1907. Boundary lines: Boundary lines marked, aided by engineer of the Republic of Panama. Monuments of 4" wrought-iron pipe, 4' long, with a brass cap suitably marked. Survey sin progress, relating to properties of the Isthmian Canal Commission, and lands claimed by private parties. **P-07,** 16.
1908. Sosa-Corozal Dam area: Survey made of this area which would have been flooded through project abandoned in favor of the dams at Pedro Miguel and Miraflores.
Monuments: Two original maps made of boundary monuments, etc., and submitted for action by Republic of Panama.
Duplicate precise level line: Mississippi River Commission lent 2 precise level men, etc., for running line across the Isthmus. Benchmarks placed.
General maps: Projection of 3 general maps of the Isthmus from data of all surveys, under way. **P-08,** 19, 20.

1909-1914. (See Meteorology and River Hydraulics.)

1914. In addition to setting corner and grade stakes for building lots in Colon and Panama, setting grades for fill in Colon, making surveys and preparing maps of estates and parcels of land in dispute before joint land commission, making surveys and inspections for department of law, and performing considerable amount of miscellaneous work, general-surveys section repaired and removed certain zone triangulation stations, made surveys and maps for other departments of Panama Canal, made locations for radio stations constructed for Navy Department, took readings on settlement hubs in Gatun Dam, and performed necessary work in connection with precise level benchmarks and monuments for tide-gauge registers at Colon, Gatun, and Miraflores. **P-14,** 27.

Surveys, Geological. (See Geology.)
Geological surveys made during the year to secure character of sites for locks and dams, classification of material to be excavated, and to determine resources of the country in regard to building materials. Valuable data obtained. Material for best grades of cement found vicinity of Gatum. **P-07,** 15.

Report on geology of the Canal Zone, by Ernest Howe. June 26, 1907. **P-07,** 108-138.

Part I: Descriptive geology. Topography: Caribbean slope, central slope, Pacific slope. Geology—Introduction. Description of formations: Obispo, Bohio, marls of Pena Blanca, Gatun, Culebra, upper limits of older sediments, acid tuffs and related rocks, intrusions of basic rocks. Development of the present topography; relation of the geology to the topography.

Part II: Applied geology. Excavation. Geology of the dam and lock site. Gatun. Introduction. Geology of the lock site; of the dam site. Character of the material filling the Pleistocene valley. Trinidad spillways. Lock site at Pedro Miguel; dike. Sosa Lock site. Dams: La Boca, Sosa-Corozal, La Boca Spillway. Materials available for purposes of construction, rock for concrete, sand. Cement materials: Burning tests of cement materials from Panama; soundness; physical character of the raw materials; amount of raw material available; kinds of material to be used; fuel; costs; effects of climate; conclusion. Lignite. General summary.

Culebra Cut: Report of geologist. "No difficulties are to be anticipated in continuing the excavation in the Culebra region except at Contractors Hill, where it is possible, but not probable, that landslides may take place when lower levels are reached. Should this danger present itself, it may be overcome by a reduction in the angle of slope." **P-07,** 138.

Dams and locks: Geology of sites. Geologist Howe reported: "The rocks at all points where locks are to be constructed are firm and hard and will make excellent foundations for the lock walls." The materials underlying the sites selected for the various dams will be competent to support the dams and will be impervious to water. **P-07,** 138.

Masonry construction materials: Geologist Howe reported: "There is an abundance of rock suitable for crushing near all points where such material will be needed.

Sand: Sand for building purposes has been found in large quantity on the Pacific coast at Chorrera, while that needed on the Atlantic side may be obtained in the vicinity of Porto Bello.

Cement materials: Raw material from which high-grade Portland cement can be cheaply manufactured on the Isthmus has been found in quantities sufficient to supply all of the cement needed.

Lignite: No coal has been found on the Isthmus, but small deposits of low-grade lignite have been found that are of no commercial value. **P-07,** 138.

Swamp.

Drainage ditch, east of Sosa-Corozal Dam, **P-07,** 57.

Open earth drains for, Mount Hope, **P-10,** 434, pl. 70.

Switchboards.

High-tension oil switch group, transformer room, Pedro Miguel, **P-13,** 110, pl. 12.

Lock-control, **P-14,** 122.

Low-tension, transformer room, Miraflores, **P-13,** 110, pl. 13.

Switch, Limit.

Motor and, cylindrical valve machines, locks, **P-12,** 108, pl. 11.

Operating machinery, locks, **P-10,** 53; **P-12,** 85.

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Tanks.

Experimental dam, Gatun, **P-08,** 196, pl. 107.

Tariff.

Duty on merchandise when entered into U. S. from zone, **P-11,** 558.

Tasking.

Task gang at work, Panama R. R., **P-09,** pl. 75.

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Executive order relating to, **P-11,** 433; **P-12,** 618.

Fees and, **P-08,** 258; **P-09,** 260; **P-10,** 367; **P-11,** 419; **P-12,** 461.

Telegraph. (See Nos. 62, 72, pp. 2362, 2363 of this Index.)

"All American" cable advocated, **P-07,** 148.

Permanent lines, Panama R. R., **P-11,** 198; **P-12,** 284.

Special rate of 25 cents obtained from Central & South American Telegraph Co., instead of 65 cents a word, **P-05,** 18.

Telephones. (See No. 62, p. 2362 of this Index.)

System and equipment, **P-14,** 17, 120.

Telephone system on the Isthmus under construction, **P-05,** 18.

Temperature. (See Meteorology.)

Absolute temperatures of record, **P-11,** 248; **P-12,** 224; **P-13,** 223.

Charts of, Gatun Locks, **P-10,** pl. 98; **P-11,** 118.

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"Teredo."

Performance of, as drill barge, **P-11,** 169.

Terminals. (See Nos. 154, 263, pp. 2364, 2368 of this Index.)

Atlantic terminals. (See Atlantic division.)

Balboa terminals. (See Pacific division.)

Boiler shop, interior, **P-14,** pl. 24.

Buildings and floor areas, **P-13,** 205.

Caissons, **P-14,** pl. 22.

Cargo handling, **P-12,** 218.

Coaling, **P-12,** 216; **P-13,** 196, 205, 209, 215, 217.

Cofferdams, **P-13,** 198.

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Construction, **P-13,** 195, 205; **P-14,** 226.

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Cristobal terminals. (See Atlantic division.)

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Shops, **P-13**, 186, 205, 206, 207, pl. 54.
Sites, **P-12**, 204, pl. 56.
Superstructures, **P-12**, 217; **P-14**, pl. 22.
Tracks, **P-13**, 195.
Wharves, **P-12**, 217.

Terminals. Operation.

1906. Terminal yards and wharves: Two larges wharves built at Atlantic terminus, and coal-hoisting plant reducing cost of handling from 23 cents to 6 cents a ton. Terminal railway yards at Cristobal finished and "a credit." Terminal railway yard at La Boca under way. New wharf provided at La Boca, providing berths for 3 additional ships. **P-06**, 8.

1911. Increase in ships touching at ports on either side of Isthmus made it necessary to extend existing docking facilities. As act June 28, 1902, contemplates construction of terminals for canal, any addition to docks should be such as to form part of final scheme, which should also include coaling facilities and dry dock as necessary adjuncts to the canal. Board appointed Apr. 24, 1911, to consider and report on facilities necessary in connection with use of completed canal, so that after general scope and characteristics of facilities adopted such work as may be needed may be undertaken. These facilities to include storing and furnishing of coal and other fuel for use both afloat and shore; furnishing of fresh water to shipping; furnishing of adequate and convenient facilities for repair of vessels, as well as of rolling stock, equipment, and machinery ashore; and question of storehouses and storing of material and supplies on the Isthmus (other than fuel) for all other purposes after the completion of canal.

Comprehensive scheme outlined having in view construction at Pacific terminus of dry dock, permanent shops, and storehouse for supplies. Coaling station contemplated at each end and arrnagement of docks which would permit subsequent additions. Dry dock is to conform in dimensions to locks, and wharves to be of sufficient dimensions to care for any shipping which can use canal; in other words, docks are to have lengths of 1,000′ and depths of water equal to depths provided in channels of approach.

On Atlantic side decided that docks should be within limits of zone, located so as not to interfere with traffic through canal and at same time enable shipping to lie at them in safety during storms. To accomplish these objects, negotiations undertaken to secure part of waterway north of Cristobal Point, which under agreement with Republic of Panama under jurisdiction of latter. Designs prepared for construction of mole extending in a general westerly direction to prism from the intersection of shore by line separating zone from Colon and of dimensions sufficient to protect against storms both docks and basin to be excavated to south of them. During year necessary borings made to determine depths to rock; trestles built for mole and for first slip of new dock; tracks laid from Mount Hope, where material is to be secured from borrow pits, to mole; and material collected for permanent construction. This involved construction of 2,100′ trestle and laying of 7,235′ track. Work will be done by Panama R. R. with its own forces.

On Pacific side tentative location selected for dry dock and for permanent shops, and arrangement made for scheme of docks. As docking facilities of Panama R. R. at Balboa very much restricted, immediate necessity for additional wharves, and under allotment from Panama R. R. of $428,700 reinforced concrete dock 706′ long and 55′ wide begun; at request of Panama R. R. work to be carried on by forces of Pacific division.

In construction of new dock at Balboa test pit and line of borings made along the outer edge of the proposed dock. Sand encountered for about 20′, below which heavy bluish-gray clay upon layer of gravel and sand overlying rock. Latter at depths varying from 60′ to 70′ below mean sea level. In construction of pier, caissons made heavily reinforced concrete shells carried down to rock and filled with concrete. Bottom section of caissons has exterior diameter of 10′ at base, tapering to 8′ at top, from which piers rise with same thickness to the top; interior diameter 6′ throughout and sections cast 6′ in height. Caissons connected by tie-girders 3′ 6″ deep by 2′ 6″ wide extending transversely between piers, and longitudinally between outside piers at elevation of −10. Floor system consists of girders running perpendicular to axis of docks, with cross section of 4′ 8″ deep by 2′ 6″ wide. Girders support system of floor beams running longitudinally along dock 3′ 9″ deep by 1′ 3″ wide, on top of which placed slabs 6″ thick. Work begun on caisson construction during last week in Feb., and on July 1 five caissons sunk to rock and 16 in process of sinking; 55 caissons in all.

1914. Division of terminal construction organized Apr. 1, 1914, under H. H. Rousseau, U. S. Navy, as engineer of terminal construction. Division embraces forces of former second division, O. C. E. engaged in design, inspection, and construction of dry docks, shops, coal and fuel-oil plants, floating cranes, docks and other terminal facilities; construction transportation by rail; road, street, and sewer work under landscape architect; and breakwater construction at Atlantic terminal.

Dry docks: General description and principal dimensions of Dry Docks No. 1 and No. 2, Balboa, given in previous report. On account of funds, decided to defer construction of Dry Dock No. 2, but such of dock structure as serves as entrance pier for Dry Dock No. 1, and as will permit future completion of Dry Dock No. 2 in dry without especial increase in cost will be built "now." Cofferdam, begun Apr. 1, 1913, to protect entrance of Dry Dock No. 1, Dry Dock No. 2, entrance basin, and coal-pocket excavations, completed by placing 103,116 c. y. Difficulty experienced through portion of double-track trestle giving way and moving outward after dumping from it had commenced, but this overcome by reinforcing outer toe by dumping material from barges, and cofferdam completed. Leakage, relatively small, controllable by pumps. In excavating for Dry Dock No. 1 and Dry Dock No. 2, coal pockets and entrance basin, old Balboa machine shops forced work to be confined to center and south sides until Nov., when they were demolished and last obstacle to excavation removed. Total taken from site of Dry Dock No. 1, 358,282 c. y., 48,838 c. y. of which earth and balance rock, making 466,975 c. y. excavated from area up to close of year. From site of Dry Dock No. 2, located just north of entrance of Dry Dock No. 1, there were removed 41,548 c. y. earth and 52,129 c. y. rock. Steam-shovel operations deepened excavation from – 13.5 to final grade for entire area of approach basin inside of cofferdam, and 351,333 c. y. removed. Area required for storage of coal and for travel of unloading towers measures 800′ in length and about 400′ in width, measured from outer edge of quay wall. Total excavation during year, 166,104 c. y., 79,837 c. y. of which earth and balance rock. Material excavated from site of dry docks, entrance basin, and coal pocket removed by steam shovels, 3 of which worked 8 hours a day until Feb., 1914, when, on Feb. 5, shovels placed on 12-hour basis and another shovel added. Shovels worked on split shifts, 12 hours a day, continuously to end of the year; 1 shovel removed in June. Contract entered into Oct. 12, 1912, for pair of steel miter-gate leaves and fixed irons, completed during the year, and material stored on Isthmus awaiting erection. Moving machines for operating leaves, together with motors, controls, and covers, also delivered.

Balboa coaling station: Upon completion of excavation for coaling plant, work begun on masonry for crane runway supports, which extend east and west through center of storage pile, and will support old Pacific division berm cranes to be reerected to rehandle coal. Material mixed by ½-yard mixer and placed by locomotive crane. At close of year all but 3 of piers over deep coal pockets up to construction joint, where girders which carry rail are to be set. Retaining wall between high and low storage pockets up to elevation 12 for three-fourths of length. Rubble retaining wall on south side of low storage area completed, as well as part of small rubble retaining wall at east end of high area. During year 1,330 c. y. concrete and 808 c. y. rubble masonry placed. In foundations for berm cranes 2,620 c. y. concrete also placed.

Total excavation accomplished, including work for dry docks, entrance basin, coaling plant, shops, quay walls, and piers, 1,513,048 c. y., of which 1,477,843 c. y. placed in fills and embankments, remainder being hand excavation wasted in excavation of foundations for shops, and orange-peel excavation thrown to one side during excavation for foundations for wharves and piers. Material used to bring shops' yard up to elevation 18 to make fill behind quay wall, piers, and area to be occupied by Panama R. R. yards, which lie east of head wall of permanent piers, for Naos Island Breakwater, and part wasted on Balboa dumps.

Shops: Lt. Col. T. C. Dickson, U. S. Army, inspector of shops, in immediate charge of design and installation of machinery of new Balboa shops until Mar. 6, 1914. Steelwork carried on by contract and completed. Total material delivered, 11,657,429 pounds. Work completed. Buildings have cement tile roofing, tiles being manufactured on Isthmus and erected in place under contract; total standard red tile squares put on, 6,441.18; gutter-tile squares, 201.15; ridge roll, 7,351 linear feet; ribbed glass pieces, 11,188. Remaining work on foundations pushed to be prepared for contractor for steelwork, and 3,221 c. y. concrete placed. All shop area brought up to grade and surfaced with crushed stone, excepting space occupied by incline from dry-dock excavation and small area between roundhouse yard and foundry. Foundations of 2 buildings interfered with by sand dock and considerable trouble experienced in placing foundations, due to obstructions in mud below low tide, consisting of old barges and other French equipment and old metal which had been dumped into area and subsequently covered up.

Installation of machine foundations in various buildings progressed rapidly as soon as it was possible to start work inside buildings. In this connection 4,944 c. y. concrete used. Shops' tunnel, which runs through building and yard parallel to axis of dry dock, completed. Proper drainage system provided over entire area.

Mechanical division abandoned Gorgona Aug., 1913, and, together with foundry and planing mill, moved direct to Balboa. Other shops transferred temporarily to Empire, and, commencing Mar. 1, 1914, gradually moved to Balboa. At close of year practically all machines erected in permanent locations and in operation. Total expended on shops, including cost of moving and installing machines, $2,384,967.33. Shops office building last one under construction. At close of year steel framework and cement tile roofing completed and construction division of supply department putting in walls and floors, and engaged in completion of building.

Breakwaters: As stated in last report, decided to construct detached breakwater on east side of Colon Harbor to protect interior harbor against waves caused by trade winds, its general direction extending out from Coco Solo to point 2,000′ east of outer extremity of west breakwater. Breakwater, as originally approved, to be 7,200′ long, its inner end 3,893′ from end of shore fill. Investigations made in various localities for purpose of securing suitable core and armor rock for use in construction, with view of doing away with necessity of further use of Porto Bello. Upon examination of comparative estimates of costs bearing on different sources of supply of rock to be used, decided to obtain rock from Sosa Hill quarry and transport it across Isthmus. Double-track trestle extended out from Coco Solo and about 11,093 linear feet completed at close of year. Railroad connection completed between root of breakwater and railroad extending from Mount Hope to Margarita Point. Auxiliary lines and sidings built in vicinity of Coco Solo Point and along Margarita Point railroad. In all, 5.2 miles new track laid. Dock 16′ by 100′, with trestle and track connections, built for unloading of materials, and small harbor for landing of launches and tugs towing piles excavated by dredge "Sandpiper," necessitating removal of 58,650 c. y. sand. A 6″ water main laid from Margarita Point main at Coco Solo turnout, and 50,000-gallon storage tank erected for watering locomotives and for additional fire protection. Coco Solo yard filled in to elevation plus 3.3, and approach tracks for trestle raised to elevation plus 14.5 Practically all tracks ballasted to main line of Panama R. R., for which 64,506 c. y. fill used in addition to 11,512 c. y. gravel ballast and 522 c. y. crushed-rock ballast.

With abolition of Atlantic division Feb. 1, west breakwater work in Colon Harbor and operation of Porto Bello quarry transferred to division. Armor rock procured from Porto Bello on old crushed-rock quarry level above two lower levels referred to in last report. Dec. 1, 1913, working hours in quarry reduced to 8 hours a day, and on Apr. 30 operation of quarry ceased. 207,654 c. y. of armor rock produced and shipped. Auxiliary excavation by steam shovels, 302,893 c. y.; wasted on shore dump. In May, 1914, quarry closed down in such a manner that it can be reopened if necessary later in connection with east breakwater. Of 207,654 c. y. rock shipped from Porto Bello, 162,951 c. y. placed by 3 derrick barges, and 44,703 c. y. placed by 3 cranes. Rock removed by dredges to extent of 18,254 c. y. placed in breakwater. Work completed May, 1914. Contains 1,945,733 c. y. material, consisting of 669,254 c. y. dredged rock, 819,930 c. y. Toro Point rock, and 456,549 c. y. Porto Bello rock.

Work on Naos Island Breakwater continued. With closing down of dry excavation in Culebra Cut on Oct. 10, borrow pit opened in side of Sosa Hill, as from action of breakwater concluded that too much soft material had been used in its construction and that nothing but rock should be put in to secure completion. Work at Sosa Hill continued Oct. 10, 1913, to Mar., 1914, when output from dry dock, together with character of material, warranted use of spoil from this locality for breakwater. At beginning of year all trestle completed to elevation plus 14 and filled in with exception of 600′. At close of year average elevation of breakwater plus 18.5; finished to full width. Average settlement during last two weeks of year, 0.075′, with exception of one stretch about 600′ in length, which settled at rate of about ¾″ per day. During portion of last three months of year settlement of about 2′ a day at south end of breakwater immediately north of Naos Island, whereas settlement at end of year only 3¾″ per day. During fiscal year 652,587 c. y. placed.

Cristobal coaling plant: Drilling and blasting channel material in vicinity of Cristobal coaling plant started by dredging division July, 1913, and removal of material by pipe-line suction dredge continued. Material pumped ashore where most needed. Largely clean coral rock and sand has been used to bring area in which coal will be stored in dry, measuring about 300′ by 1,200′, up to elevation plus 2. Work pushed on construction of trestles for use in setting 6′ caissons and on construction of two concrete walls supported on piles, about 700′ in length, that carry tracks for stocking and reclaiming bridges. At end of year trestle construction about 25 per cent completed. Caissons of steel, 6′ in diameter, and by end of year 78 cylinders had been set, and 6 of these driven to rock with steam hammer in advance of any excavation. Total concrete placed, 3,123 c. y.

Contract entered into for materials, necessary machinery, and erection in place of coal-handling plants. Coal-handling plants designed for storage of 485,000 tons at Cristobal and 215,000 tons at Balboa. Of the former, 100,000 tons to be wet storage, and latter 50,000 tons.

Fuel-oil plant: Contract entered into Oct. 1, 1912, for 4 fuel-oil storage tanks, 93′ in diameter and 35′ in height, each having capacity of 40,000 barrels; cost, $62,800. Two located at Mount Hope and two on Balboa dump southeast of Sosa Hill. Plans prepared and advertisements issued for necessary pumping plants in connection with these tanks, one at Balboa and one at Mount Hope. Provision made for installation of 3 pumps in each plant, 2 of which will be purchased at present time. They will be able to handle oil from Balboa to Miraflores tank, and from Mount Hope to Gatun tank, at rate of about 400 barrels an hour. On Atlantic side as much of Docks 13 and 14 as necessary will be used as oil docks, and tank field will be located between east diversion and Mount Hope Road, where there are suitable locations for 40 or 50 tanks. Pumping plant will be located immediately east of Mount Hope filtration plant. At Pacific terminal there will be berth for oil vessels 75′ wide by about 2,000′ long immediately adjoining canal channel and south of old French pier. There will be 3 oil cribs, 2 of which will be constructed at once, consisting of steel and concrete deck supported by 6′ concrete cylinders. Pumping plant will be located on lower level of Balboa dump, opposite oil cribs. Tank field laid out on higher level of Balboa dump. Area reserved for accommodation of 33 lots each 200′ square. To end of fiscal year expended on fuel-oil plant at Pacific terminal, $50,289.33, including cost of dredging berth for ships, for which removed 60,776 c. y., and on that at Atlantic terminal $49,694.15.

Quay walls and pier: Work continued on quay walls and pier at Pacific end. These consist of reinforced concrete deck supported by cylinders sunk to rock. Total length of quay wall or wharf will be 2,662.65′, averaging 60′ wide. Of this, 648.78′ built for Panama R. R. as lumber dock; remaining portions of wharf extend to north and south of this lumber dock. North portion supported upon cylindrical concrete caissons sunk to rock and filled with concrete, reinforced with steel rails. Cylinders themselves reinforced concrete 7′ 6″ in diameter, with 8′ bottom section 5′ in length. Of section north of lumber dock, 1,238.42′, 16 caissons remained to be sunk, most of substructure having been completed during previous year. 136 caissons in this dock. Superstructure consists of reinforced girders, beams, and floor slab, with vitrified brick surface. Work begun July, 1913, and completed Feb. 1, 1914. Paving brick laid on sand cushion. 75,683 sq. feet of brick laid on floor of this dock, and completed Apr. 1, 1914.

To counteract any outward pressure against cylinders, "dead men" placed in ground about 85′ behind rear edge of wharf and opposite each transverse girder, each with effective bearing area of 48 sq. feet, constructed of reinforced concrete. They were connected to dock by steel rods 2½″ in diameter, drawn tight by means of turnbuckles, and incased in concrete.

Wharf south of lumber dock 775.45′ in length with return 200′ long, and, as work had to be performed in water, reinforced concrete caissons used in other dock not suitable. Caissons for this portion of work steel cylinders 6′ in diameter, in sections 5′ long. To permit construction of portion of wharf, necessary to remove sand-unloading cranes formerly used by Pacific division, and sand operations transferred to Miraflores Locks. Ladder dredge cleared site and double trestle constructed longitudinally through site for handling of caissons. Excavation inside the cylinders performed by orange-peel buckets as much as possible, but material overlying hard rock so firm that greater part of excavation had to be done by hand, using Star well drills as hoisting engines. At close of year 23 caissons sunk to rock.

Bulkhead quay wall, extending between wharf and Pier No. 1, 300′ long and built on concrete cylinders sunk to rock in manner similar to that at wharf north of lumber dock. Rock encountered very much higher than on greater part of other quay walls, and it was necessary to do considerable rock excavation in caissons to get them well below −45. Excavation done by orange-peel buckets operated by locomotive cranes, but removal of rock and cleaning out bottom of caissons required hand excavation. 65 piers required for this dock. All sunk to rock at end of Feb., 1914. Superstructure placed similar to that of other docks. Similar bulkhead, extending from Pier No. 1 to Pier No. 2, begun during year.

Construction of Pier No. 1, 1,000′ in length and 201′ wide, proceeded in manner similar to that of wharf construction, both as regards excavating in caissons and placing superstructure. Most of material excavated soft, alluvial mud, rock being encountered at upper end, which necessitated hand excavation in order to secure foundation for cylinders. During year 184 piers sunk to rock.

Dock completed during year; area of 77,403 sq. feet, and total division cost $421,200.57.

At quay wall south of lumber dock, in dredging preparatory to construction of dock, 25,720 c. y. removed; 669 c. y. excavated for and in piers; in filling caissons, 1,487 c. y. concrete placed. To close of fiscal year expended in construction of this dock, $107,956.85. In construction of bulkhead quay wall, extending between wharf and Pier No. 1, 7,835 c. y. excavated in and for piers. In construction of caisson shells, 1,657 c. y. concrete used; 3,563 c. y. concrete placed within cylinders; 2,462 c. y. concrete placed in concrete floor; and 21 c. y. in concrete balustrade. Behind structure, 2,313 c. y. back fill placed. Total expended on quay wall to end of fiscal year, $130,306.14.

In construction of pier, 31,666 c. y. excavated for and in cylinders. In construction of caisson shells, 10,773 c. y. concrete used, and 13,346 c. y. concrete used in filling caissons. In connection with floor system there were excavated 7,378 c. y.; 10,222 c. y. concrete laid in floor, and 939 c. y. back fill placed. To end of fiscal year there were expended in construction of this pier $511,749.14. Total expense in connection with these docks, including preliminary expenditures not located to any of docks, to end of fiscal year, $1,212,917.01.

Ancon quarry: Ancon quarry continued—by fifth division, July 1, 1913, to Feb. 1, 1914; by fourth division, Feb. 1, 1914, to May 31, 1914; and from latter date to end of year under division of terminal construction. Greater part of work carried on on upper level, over 400′ above crushers. Two shovels kept at work until May, 1914, since which time one shovel operated and other held in reserve. In July, 1913, bank under crusher building gave way and threatened to carry away lower part of crusher building and conveyor. Material in slide excavated by steam shovels, working day and night, and about 40,000 c. y. removed and hauled to Miraflores Locks for back filling and to Balboa town site. During this time crushers ran 12 hours a day until danger from slide stopped. Large crusher relined once, main shaft changed twice, and main eccentric changed twice in order to be rebabbitted.

Larger output from quarry designated as rock No. 1 and smaller No. 2. Demand for latter size greater than formerly, and crusher arranged to crush the rock smaller. Total crushed rock, 502,798 c. y. In addition, 49,156 c. y. screenings produced, utilized in construction and repair of roads and in manufacture of concrete blocks for construction of buildings.

Sand service: Handling of sand from Chame to Balboa performed by dredging division, and unloading at Balboa continued under dredging division until Feb., 1914, when unloading cranes at Balboa closed down, owing to necessity of moving them off temporary dock on which they had been installed. Unloading operations transferred to Miraflores Apr. 28, and unloading performed by one of berm cranes still remaining. Locomotive crane subsequently added, and both machines worked during May and June. Total of 199,319 c. y. sand received and unloaded.

Panama R. R. freight yards: Panama R. R. freight yards, Diablo Hill to foot of Sosa Hill, practically completed at end of year. Filling and excavation for these performed by division of terminal construction. Material excavated from inner harbor by suction dredges deposited through pipe lines into swamp lying between site and old Panama R. R. line, and considerable amount of dry fill obtained from dry-dock excavation and from Diablo Hill added. Low, swampy area east of Balboa terminals and north of Ancon Hill raised to higher elevation by hydraulic fill dredged from inner harbor.

Colliers: Successful operation of coaling plants, as well as price at which coal can be sold, dependent in some degree upon the ability to control transportation of coal from U. S. During year cost of water transportation $1.395 per ton. Coal brought down in foreign bottoms. Conclusion reached early in consideration of coal-supply problem that advantages would result from ownership by Panama Canal or Panama R. R. of colliers bringing coal to Isthmus. Estimate submitted in 1912 that would permit construction by Panama Canal of two colliers in accordance with latest type of naval design, and would give Panama Canal desired control over its coal supply. General plans prepared by Navy Department, and bids opened Feb. 2, 1914. Apr. 9, 1914, contract entered into at $987,500 each; each to have coal-carrying capacity of 12,000 tons and speed of 14 knots per hour loaded to full capacity. June 30, 1914, Sec. of War decided these colliers will be operated by Panama R. R. Panama R. R. has submitted estimate of cost of transportation, 97 cents ton, not including depreciation or interest on capital invested.

Tugs: Estimate for 1913 included purchase of 4 harbor tugs of suitable design and sufficient power to handle largest vessel using canal. Plans and specifications approved Dec., 1913, and bids invited Jan. 6, 1914. When bids received, decided to reduce number from 4 to 2, and contract entered into May 8, 1914.

Floating cranes: Contract entered into Apr. 21, 1913, for 2 floating cranes of revolving type, and 250 tons capacity each, at cost of $837,500, to be delivered and completed on Isthmus within 580 days, or by Dec. 2, 1914; named "Ajax" and "Hercules," respectively. Pontoons brought from Germany and arrived on Isthmus July.

Balboa town site: Planning of permanent town of Balboa, together with streets, water and sewer systems, placed under this division. Previous study had served to determine location of administration building, and formal mall of buildings on Balboa Plain as recommended by Commission of Fine Arts. Main roadways have width of 24′; roadways of secondary importance have

width of either 18′ or 14′. Land which has been set aside for permanent gold site at Balboa includes 29 acres on north and northwesterly slopes of Sosa Hill, intended generally for quartering employees assigned to shops and terminals; area of 72½ acres on southwesterly slope of Ancon Hill, named "Balboa Heights." Employees working in administration building will be housed in this area. Third area, 55 acres, on low ground between two areas above mentioned, on which will be located buildings of public or semipublic character, as well as quarters. Construction started Aug., and progress governed to considerable extent by existing structures and tracks. Sewer and water systems installed and considerable trading and planting completed. Total expended on work, $409,116.35.
Radio station: In addition to foregoing work, building of Darien radio station placed in charge of this division and $74,756.88 expended. **P-14**, 35–46.

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Timbering.
Timbering and lining tunnel, Miraflores, **P-09**, 142, pl. 70.

Timekeeping, P-14, 60, 405.
1913. Jurisdiction of Q. M. department extended from Porto Bello to Balboa, and timekeeping centralized in the chief Q. M. office. To this force later assigned timekeeping for various offices at headquarters. When first division undertook installation of machinery at locks the timekeeping of this division also turned over to timekeeping force of Q. M. department. Same done when fortifications division organized, and results obtained from consolidation so satisfactory as to lead to consolidating all timekeeping under one head. This done gradually under examiner of accounts, in order that it might be properly started, and when all work of this kind for all departments and divisions, except central division, combined, timekeeping force turned over as part of organization of fourth division of O. C. E. July 1, 1913. **P-13**, 1, 2.

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Tolls. (See Orders, Executive.)
1911. Tolls and opening of canal: Estimated date for completion of canal, based on report of Board of Consulting Engineers, 1906 (see No. 183, p. 2365 of this Index), fixed at Jan. 1, 1915. Meantime, work advanced rapidly, and apparent it would be possible to pass vessels at least a year earlier. Shipping

interests of world raised question of tolls in July, 1910, and urged early settlement. Attention called to fact that at least 18 months' notice of rates should be given that steps might be taken in time to change routings that would follow if canal were used. Inquiry developed fact that organization of new companies for use of canal contemplated, provided rates should be attractive. Developed, also, that two years' advance notice desired to permit building of necessary ships.

To determine date when canal would be ready, a board convened, composed of those charged with the work. Announcement made that all concrete in locks at Gatun would be laid by June 1, 1912, and in locks on Pacific side by Oct. 1, 1912; that, assuming gates completed by June 1, 1913, locks would be ready for use on this date if operating machinery installed; that work on spillway at Gatun would be completed to elevation 50′ by Apr. 1, 1912, and entire dam finished by close of dry season of 1912-13; that excavation through Culebra Cut would be completed by July 1, 1913, if no more material due to slides had to be removed than was estimated; and that exterior channels would be sufficiently advanced to pass shipping.

Need for legislation to fix tolls urgent. Time can be saved in making public announcement of rates by compiling, in advance of legislative action, data of amount of traffic that will probably use canal and formulation of rules by which tonnage of ships to be determined. Steps to this end taken. **P-11,** 58-60.

1912. Division engineer of the central division reported at close of year that if no more material due to slides had to be removed than increase which revised estimates of July 1, 1912, contemplated, excavation through Culebra Cut would be completed July 1, 1913, or the same date fixed a year ago. Though additional slides have occurred since close of fiscal year, there has been no decrease in force, so that it is still possible to complete it as predicted, though date must depend upon slides. In Atlantic division concrete work at north end of locks remains to be completed. Excavation in area below by dredging not begun until Feb., 1912, and reported by division engineer that, due to slides, date for completing concrete will be June 30, 1913. On account of increase in additional quantity of dry fill to be added to dam, July 1, 1913, now date fixed for completing this work, and Aug. 1, 1913, fixed as date for completing Gatun spillway.

In the Pacific division the division engineer estimates locks will be completed by Jan. 1, 1913, by which date dams at Pedro Miguel and Miraflores will also be finished, and spillway at Miraflores Locks will be completed by June 30, 1913. Delay of 7 months in delivery of dredge "Corozal" threatened delay in completing excavation in channel below Miraflores by the amount estimated dredge would remove in that time. A large portion of excavation will be done by steam shovels, thus reducing length of time sufficiently to permit completion of channel by June 30, 1913.

Contract for lock gates not been carried out as rapidly as expected, and contractor called upon to finish gates in one flight of locks first, so that, if rest of work is in condition, passage of ships can be permitted by use of one flight. Delays in delivery of lock machinery and accessories, but assistant chief engineer so organizing work as to have completed sufficient machinery to meet conditions that lock-gate contract will furnish. Probable that certain features of work will not be finished until some time after first vessel passes locks, such as power-generating station, transmission line, aids to navigation, etc., which, though important, not essential to preliminary trial of system. **P-12,** 66, 67.

1913. Concrete work of locks completed, and but for slides central division would also be finished. Contract for completion of gates extended and contemplates finishing up all work on one flight throughout by Oct. 1, 1913. Work on installation of operating machinery concentrated to meet this condition of lock gates, and believed that one flight of locks throughout will be ready for operation Oct. 1, 1913, except fender chains and control houses, but electrical current from existing power plants will be usable until completion of hydroelectric station. Assuming the lake level at elevation 50, July 1, with average rainy season, lake should reach elevation 85 by Dec. 1, 1913. Rainfall during May excessive and above average; rainfall during July below average, so that the lake has not reached elevation that it should have at this time by about 3½′.

Slides which occurred to prevent completion of cut as anticipated a year ago are at Cucaracha, east side opposite Culebra, two in vicinity of Empire suspension bridge, relatively small, and one opposite White House. With exception of Cucaracha slide, these could probably be removed in dry by Jan. 1, 1914, but removal of Cucaracha slide in dry would require until Apr., 1914. Material can not be handled expeditiously by steam shovels during wet season, but lends itself to economical removal by hydraulic dredges. Except at Cucaracha, existing channel by slides is to full depth and of a width of at least 200′ at bottom. Assuming that all slides were removed by steam shovels in dry, water in lake could not be raised above elevation 60 and still be kept out of cut by dike at Gamboa, so that after advent of dry season it would not be possible, under normal conditions, to secure full lake level

until Oct. or Nov., 1914. Material in all slides can be handled advantageously by dredging fleet, augmented, as it will be later, by two 15-yard dipper dredges under contract. They will operate against banks in every case and will not be excavating for full depth of 45′. Sea-level sections by time dredges can be moved into cut will be in condition for passage of ships of heaviest draft.

General belief that effect of water in cut would retard slides and experience below Gatun Locks in sustaining power of water against slides fully justifies this belief; on the other hand, geologist of opinion that water may to some extent develop new slides. Again, much ado made in 1909 over seamy character of rock on Isthmus, through which water flows quite rapidly, in consequence of which question raised that lake might leak out through seams and crevices. If these things liable to occur, sooner the better, if official opening of canal is to occur Jan. 1, 1915; for if water were not admitted "this" fall, but were deferred until May 1, 1914, full height could not be reached until Oct., 1914, leaving little time for determination of these questions. These considerations led to conclusion that water should be turned into cut at earliest date practicable for getting dredges to work on slides. Dredges can be passed into cut as soon as gates of one flight completed, and this is reasonably certain to be the case by Oct. 1. With average rainfall, lake should reach elevation approximately 70 by Oct. 10, and greater height of water against dike which excludes lake from cut at present would not be safe. Present plans based upon blowing up of Gamboa Dike Oct. 10, its removal by dredges immediately thereafter, transfer of two suction dredges and ladder dredge "Corozal" to Cucaracha slide, smaller dipper dredges to work on other slides until full width of channel attained, and passage of vessels through canal as soon as channels of full depth and of sufficient width secured.

Erroneous impression caused by announcement that water will be turned into cut Oct. 10, as it seems to have been assumed that canal will be practically finished on that date. Before boats can be passed it will be necessary to remove Gamboa Dike by dredges and to remove slides as already outlined. Passage of commercial vessels dependent, therefore, upon the time when proper channels can be dredged through slides; should additional ones occur, they will necessarily advance the date when this will be accomplished. **P-13,** 69–71.

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Warwick, W. W.
Examiner of accounts, reports. (See No. 237, p. 2367 of this Index.)

Washington Office. (See Nos. 144, 227, 274, pp. 2364, 2366, 2368 of this Index.)

1907. Until Mar., 1907, the main office of the Isthmian Canal Commission. Reorganized later. In charge of general purchasing officer. Considerable saving in expense. **P-07,** 34.

1908. Purchases: By Executive order Aug. 15, 1907, placed under the supervision of the Chief of Engineers, U. S. Army, who was authorized to maintain purchasing department in the office of the Isthmian Canal Commission in Washington.

Divisions: Under the direction of the general purchasing officer, who acts as chief of office. General office, general counsel, disbursing office, assistant examiner of accounts, appointment, correspondence, and record divisions, and purchasing department.

Inspections: Part of the inspecting engineer's office was transferred from New York to Washington.

Appointments: 2,160 persons tendered appointments; 1,947 accepted; 5,397 persons given transportation to Isthmus.

Claims: 10,956; value, $13,728,288.51. Paid by the disbursing officer in the U. S.

Purchasing offices: Assistant purchasing and shipping agents in New York, New Orleans, and San Francisco. Tacoma office closed; its work undertaken by U. S. engineer offices of Seattle and Washington.

Bids: Circular invitations for bids prepared from requisitions received from the Isthmus, and distributed throughout the country. Practice of allowing bids to cover delivery of materials on the Isthmus has given all sections equal opportunities. **P-08,** 34.

1909. Duties: Same scope as in previous year.

General counsel: Maintained until Apr. 1, 1909, when he was continued in the position of counsel to the Panama R. R. only, and moved in that capacity to New York.

Employment: 1,466 tendered employment on the Isthmus; 1,033 accepted and were appointed, covering 158 different positions, of which number 754 reported on the Isthmus and were assigned to duty by the Q. M. department.

Disbursing division: Paid vouchers for material and services aggregating $15,311,021.12. Duplicate set [illegible] general books of the Isthmian Canal Commission kept.

Claims of employees injured: Assistant examiner of accounts assumed charge of such claims arising under act May 30, 1908. Since May 6, 1909, prepared all commission contracts and bonds.

Inspections: Total amount of purchase orders placed during the year, $16,536,130.42. Preliminary inspections made. **P-09,** 32.

1910. Work of office continued in charge of Capt. F. C. Boggs, Corps of Engineers, U. S. Army. 2,022 persons within U. S. tendered employment on Isthmus in grades above that of laborer, of which [illegible] accepted and appointed, covering 125 different positions. Total purchase orders placed during year, $16,[illegible]07,350.34; most important of purchases castings, structural material, and valves for use in locks, amounting to $847,000; 4 steel barges; 2 tugboats; 3 launches; one 20″ pipe line suction dredge; 1 hydraulic and dredging plant; 13 dredging, discharge, and relay pumps; 449 dump and flat cars; 10 cantilever cranes; 2 rock crushers; 8,745 tons of steel rails; 655,842 crossties; 32,715 piles; 30,771,744′ of lumber; 14,742,400 pounds of dynamite and blasting powder. Shipments of cement for use in the locks and dams, purchased under contract for 4,500,000 barrels, amounted to 904,727 barrels up to June 30. **P-10,** 46.

1911. During year 1,706 persons within U. S. tendered employment on the Isthmus in grades above that of laborer, and 1,083 accepted and appointed, covering 58 different

positions. Total purchase orders placed during year, $6,976,066.59. Most important contracts for 6 emergency dams for locks, amounting to $2,238,988.40, and for machinery and materials entering into construction and operation of locks, amounting to $2,456,482.23. Other principal items purchased were: One twin-screw steel ladder dredge with hopper capacity of 1,200 tons of spoil, 2 locomotive cranes, 1 electric trolley crane, 12 concrete mixers, 2 narrow-gauge locomotives, 1 unloader plow, 19,577,589′ of lumber, 3,400 tons of steel rails, 2,775 piles, and 8,000 frames for concrete piles. During year 3 independent inspecting offices established for inspection of lock gates and materials which enter into locks and movable dams. **P-11**, 56.

1912. During year 1,296 persons within U. S. tendered employment for duty on Isthmus in grades above that of laborer; 632 accepted and appointed, covering 51 different positions. Total purchase orders placed for fiscal year, $10,446,551.23. Most important contracts for permanent equipment in form of structural lock material, $386,274.60; electric locomotives and tracks, $249,258.44; spillway gates and materials, $526,697.03; machinery for operation of locks and spillways, $2,271,582.01; and hydroelectric station, $156,586.58. Other important purchases included 10,105,000 pounds of dynamite, 34,424,500′ of lumber, and 7,259 gross tons of steel rails. Under contract for 4,500,000 barrels of Portland cement entered into Jan. 7, 1909, 4,354,024 barrels shipped, of which 1,579,210 barrels delivered during past year. During year 3 independent inspecting offices continued for inspection of lock gates and material which enter into construction of locks and dams. **P-12**, 66.

1913. Work made more difficult and arduous by the fact that, in the desire to reduce the amount of stock on hand, the number of rush orders increased. 2,065 persons within U. S. tendered employment for duty on Isthmus in grades above that of laborer; 1,183 accepted and appointed, covering 59 different positions. Total orders placed for fiscal year, $12,335,973.12. Most important contracts for permanent equipment: Structural material for locks and spillways, $241,326.33; machinery for operation, $740,302.02; electric locomotives and tracks, $548,732.67; hydroelectric station, $72,540.34; dock material, $571,723.48; shop buildings and machinery, $593,649.51; transmission line, $688,503.38; and two 250-ton revolving floating cranes, $837,500. Other principal items of purchase included two 15-yard dipper dredges, 6,310,000 pounds of dynamite, and 23,505,695′ of lumber. Supplemental contract entered into Sept. 13, 1912, covering additional quantity of cement necessary to complete work. 1,303,762 barrels of cement purchased. **P-13**, 68.

1914. Apr. 1, 1914, under provisions of Executive order Mar. 2, 1914, office of assistant auditor created in place of office of assistant examiner of accounts. Under assistant auditor was placed disbursing clerk, and disbursing office abolished. Scope of work about same as previously reported, except that practically all of independent inspection forces located at points in U. S. outside of Washington abolished or greatly reduced. Due to continued effort to reduce material on Isthmus to minimum, work of purchasing department even greater than during previous fiscal year.

2,248 persons within U. S. tendered employment for duty on Isthmus in grades above that of laborer; 1,429 accepted and appointed, covering 71 different classes of employment.

Total orders placed, $12,392,407.78. Many of largest contracts for permanent equipment: Chain fenders and chain, $192,865.90; coal-handling plants, $1,929,103.85; terminal facilities and docks, $224,004.44; floating caisson, $333,851.20; single-track movable span bridge, $55,674; transmission line, $505,511.84; filtration plants, $150,576.79; material and equipment for buildings and quarters, $53,824.02; Balboa shops, buildings, $155,547.89; machinery, $146,367.16; two 12,000-ton colliers, $1,975,000; 2 tugboats, $304,000; and 9 gasoline motor boats, $54,392. Other principal items purchased included 2,490 pounds of explosives, 22,200,000′ of lumber, 20,000 crossties, and 18,311 piles. During year 592,674 barrels of cement purchased. **P-14**, 62, 63.

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Water supply. (Operation.)

1904. Waterworks and sewer system, Panama and Colon: Force for designing and constructing waterworks and sewer systems sailed from New York soon after organization, June, 1904. Various plans considered. Rio Grande Reservoir for city of Panama system; water tested and found satisfactory; best waterworks practice followed. No sewers or drainage system in Panama. City divided into 3 sewer districts, sewage discharged into sea water of Panama Bay; total estimated cost, $256,450. Difficult to find wholesome water for Colon. On account of lowness of Colon, sewage system a problem also. **P-04,** 44.

1905. Water turned into pipe lines, for supply of Panama, Colon, etc., from the reservoir made by dam across Rio Grande, and Brazos Brook. Reservoirs, and distributing systems established. **P-05,** 13.
Establishment of modern reservoir systems in progress. When piped water was turned on for Panama City the Te Deum was sung in the cathedral, attended by the President of the Republic, etc. **P-05,** 39. View showing opening of the waterworks system, Panama, July 4, 1905, **P-05,** 40.

1906. Water and sewer systems, Panama: Water system complete; at the end of the dry season a year's supply of water remained in reservoirs; "the best paved, best watered, and best sewered city in Central America, or in the northern half of South America," **P-06,** 8.
Water and sewer systems, Colon and Cristobal: Abundant supply of pure and wholesome water from receiving reservoir 2 miles back from Mount Hope, with a capacity of 508,000,000 gallons. Installation of sewer system for Colon begun. Paving under way. **P-06,** 9.
Water commissioner: Plumbing regulations devised. Rates established for water service. Meter system being installed at Panama. **P-06,** 35.
Colon water supply: In dry season, 1906, necessary to supply water to Colon with a water train hauling daily 200,000 to 250,000 gallons; at no time did Colon or Cristobal suffer; more water per inhabitant than ever known

before; charges that salt water pumped through mains "absolutely and unqualifiedly false." **P-06,** 98.

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  Improvement. Demand in U. S. insistent for deeper, wider, and straighter channels. Minimum channel width of 1,000 standard for ocean ports. Continuous growth in capacity of internal waterways, such as canals. Instance of waterways connecting the Great Lakes.
  Navigation, needs of. Widths; curves. Curvature made by ships [illegible] the [illegible] at head of Little Mud Lake.
  Delays in channels: 1,698 hours in Weitzel Lock, St. Marys Falls, 1881–1905; 1,104 hours in Poe Lock, 1896–1905. **P-06*,** 421–423.

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To act as clearing houses for dirt trains, practically completed at each end of the line. **P-06,** 8.

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1905. Important to stamp out source of yellow fever in view of danger of transmitting it by canal traffic to other portions of the world. Elimination of the disease as difficult as the engineering problem of the canal. Epidemic during first 10 months of American occupation. Panic among Americans. Chief sanitary officer assured of entire resources of the Isthmian Canal Commission to stamp the disease out. Campaign adopted to prevent propagation of mosquitoes, to isolate all infected persons, and destruction of all mosquitoes capable of transmission. Stegomyia brigades formed. With apparatus, these brigades destroyed nineteen-twentieths of sources of propagation, open receptacles, pools, etc. Medical inspectors appointed. Houses fumigated by a special fumigating force. Cities of Colon and Panama fumigated. Gradual decrease in death rate. Finally wiped out. **P-05,** 29.

1906. Bocas del Toro: Yellow fever reported here Feb., 1906. Upon urgent representations, the Panama authorities appointed representatives of the Isthmian Canal Commission sanitary department to clean up, part of the expense being paid by the U. S. **P-06,** 23.

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- Panama R. R., map [illegible] [illegible]cated line, **P-11**, [illegible]
- [illegible]ation, statistics, **P-09,** 326. (See No. 226, p. 2366 of this Index.)
- Treasurer to be disbursing officer of Isthmian Canal Commission, **P-04,** 53.
- Waterworks systems, **P-08,** 88.

Zone, Operations.
- **1904.** Government of zone: The Isthmian Canal Commission required by President Roosevelt under authority of act Apr. 28, 1904, "to make all needful rules and regulations for the government of the zone and for the correct administration of the military, civil, and judicial affairs of its possessions until the close of the 58th Congress." Governor appointed by the Isthmian Canal Commission. Organization of administration of government into three branches—legislative, judicial, and executive. Outlines of the duties of each branch. Zone divided into 5 municipalities; organization outline. List of various laws enacted. Penal and criminal codes enacted, being adaptations of those in force in Porto Rico and the Philippines. **P-04,** 65, 70.
- Organization: Maj. Gen. Geo. W. Davis, selected by Isthmian Canal Commission No. 2 to represent the commission on the Isthmus May 8, 1904. Appointed by President Roosevelt; outline of his powers. Col F. J. Hecker appointed to cooperate with Gov. Davis. May 17, 1904, the Government of Panama publicly announced recognition of Gov. Davis's authority over the zone. **P-04,** 77.
- Panama officials at transfer ceased holding office as such June 16, 1904. List of tax sources of Panama régime. **P-04,** 82, 83.
- Industries and social conditions: Primitive conditions; 2 schools in each town, with poor attendance. No highways outside villages; no masonry buildings. Only industries, cane growing and manufacture of rum. Only exports, bananas and coconuts. **P-04,** 82.
- Postal affairs: None before U. S. occupancy; U. S. domestic rate established, and stations, etc., June 24, 1904. Issue of counterfeit Panama stamps not traceable to zone government. **P-04,** 84.
- Jails: Jail erection planned; primitive [illegible] in vogue, **P-04,** 86. [illegible] of zone estimated.
- Lands and [illegible] details. Classification of ownership of lands. Lands which will be needed by the U. S. Old buildings of the Panama Canal Co. leased during cessation of work, and lease continued by U. S., with revenue of about $30,000 annually. Boundary lines of plots throughout zone indefinite. **P-04,** 91.
- Telegraphs and telephones: Old equipment meager. Modern system begun. **P-04,** 94.
- Public works: No roads except one at or near city of Panama; to be improved and maintained by the U. S. No great necessity for immediate road work. **P-04,** 93.
- Justice and judiciary: Transfer caused a lack of local judges. Zone judiciary created. Circuit court began sessions; judge in each municipality. One circuit judge, etc., held to be plenty. Recommended that appeals be taken out of zone. People not litigious. **P-04,** 85.
- Municipalities: Zone divided into 6 municipalities. General description of buildings. **P-04,** 81.
- Geography: Panama divided into Provinces, and these into municipalities. Canal route traverses two of these Provinces (Colon and Panama), embracing some 8 municipalities. System of straight dividing lines established, abolishing the existing tortuous ones, the straight lines being determined by the direction of the probable axis of the canal. **P-04,** 80.

Public order: Old Panama Co. property protected by a special force, for the payments of whose services the Republic was reimbursed by the company; continued after transfer; later men were paid directly by the U. S.; establishment of zone police under way. **P-04,** 84.

1905. Delimitation of zone: To settle disputes about tax paying, survey made of the boundary line of the zone. Permanent boundaries not fixable until center line of canal definitely fixed. **P-05,** 47.

Revenues: Organized into 7 divisions—customs and internal revenue, posts and correspondence, lands, records and personnel, accounts, administration of estates, schools, **P-05,** 62.

Taxation of old régime continued. License taxes for rum distillation collected from 8 distilleries. **P-05,** 64.

Zone government: Executive order embracing the duties of governor and general auditor, covering the revenues and expenditures of the government of the zone. Authorization dated Apr. 1, 1905, the White House. Subjects: The general auditor; the local auditor; the chief clerk; accounts of Treasury deposits and withdrawals; revenue accounts; money-order accounts; jurisdiction of the auditor; reports; depositary of Canal Zone; title to be observed in the rendition and certification of accounts; appeals from the action of the auditor. Approved for the President by [illegible] of War Taft, Nov. 5, 1905. **P-05,** 101.

1906. American [illegible] preserved. Rights of citizens being preserved. [illegible]

1907. Department of civil administration embraces affairs of government of zone, courts, office of prosecuting attorney, and division of revenues, posts, lands, administration of estates, police, education, fire protection, and public works, **P-07,** 27.

Governor Magoon left Isthmus Sept. 25, 1906.

Executive order Nov. 17, 1906, created department of law and government under the general counsel; governmental matters handled in Washington by general counsel subsequently.

Executive order Apr. 2, 1907, vested authority of chief executive of the zone in the chairman of Isthmian Canal Commission; duties assigned to one of the commissioners.

Five municipalities abolished; administrative districts created in their stead.

U. S. patent, trade-mark, and copyright laws extended to zone.

Provisions made for regulating insurance companies, for registration of land titles, and celebration of marriages.

Penal laws amended; new code of civil procedure effective.

Isthmian Canal Commission authorized, order Mar. 13, 1907, to enact, with the approval of the Secretary of War, ordinances relating to police, sanitation, and taxation, and matters formerly regulated by municipal ordinances. **P-07,** 27.

A commission, of U. S. and Panama representatives, unable to agree on value of certain property affected by canal operations, except the islands in Panama Bay. Payment by U. S. of $54,037 recommended in case of claims connected with Malambo fire.

Question raised by Panama as to right of the Central & South American Telegraph Co. to land its cable through Manzanillo Bay; claim of Panama would make ends of canal under Panama control.

Contracts made July 1, 1907, with Panama concerning water rates in Panama and Colon, from which the U. S. will gain reimbursement for sanitary work, etc., done in the 2 cities.

37.31 miles of roads and trails built; expected to increase agricultural leases.

Questionable if extradition laws apply to zone; considered advisable to extend U. S. status to zone by Executive order.

56 undesirables deported exclusive of the chronically sick.

16 post offices; 90,928 pieces registered; money orders amounted to $2,318,965.34, employees finding money-order system a safe depositary for their money.

Customs service of zone confined to entering and clearing vessels arriving at ports of Ancon and Cristobal. Docks built, equipped with modern appliances.

Distillation licenses to total of $5,198.95 collected.

479 leases for building lots; 83 for agricultural lands.

Collector of revenue administered 29 estates.

Funds of [illegible] from rental of land, etc., postal service, [illegible] and fines, and taxes. Expenses of school system, [illegible] of public improvements, etc., paid from these revenues, but postal returns applied solely to that service.

358 civil cases settled in courts. Cases of Coulson and Andrade, among other cases, settled by supreme court. Coulson was convicted in circuit court of murder and sentenced to death; court denied trial by jury; supreme court affirmed circuit court decision. Andrade was ejected from property he claimed; argued Government must prove its title to lands; supreme court held that statute of limitations does not run against the Government, and burden always upon a person claiming adversely to the Government to prove title.

181 officers and men June 30, 1907. 6,236 arrests; 5,193 convictions. As marshal of the courts, chief of police served 310 summonses, 663 subpœnas, and levied 4 executions; acted as coroner at 136 inquests.

Additional fire stations installed; paid firemen increased; volunteer companies organized.

Superintendent of public works operated Panama waterworks and sewer systems. Average daily consumption, 749,800 gallons. Progress made at Colon on such operations.

24 schools opened during year; 31 teachers on rolls; average enrollment, 1,643; attendance, 1,138. **P-07**, 27–31.

1908. Organization: Executive branch includes executive office; the division of posts, customs, and revenues; police and prisons, schools; fire protection; public works; and the office of the prosecuting attorney. Judicial branch includes the supreme, circuit, and district courts. Head of department represents the Isthmian Canal Commission in its relations with the Republic of Panama and foreign representatives accredited to Panama.

Beyond-zone relations: Satisfactory; questions arising on basis of treaty with Panama settled satisfactorily. "The officials of the Republic have manifested at all times a desire to aid the work of the Isthmian Canal Commission."

Legislation, etc.: By Congress, includes provision respecting the use of local revenues of the zone, employer's liability act, and the act providing for compensation of Government employees injured in the performance of duty. By Executive order, Chinese-exclusion law of Panama extended to zone; and trial by jury for criminal prosecutions involving death penalty or life imprisonment.

Ordinances prescribing building regulations, providing for the impounding of stray animals, and revising the liquor regulations and the schedule of general taxes and license fees collected in the Canal Zone enacted by the Isthmian Canal Commission and approved by Sec. of War.

Posts, customs, and revenues: Postage-stamp sales, $72,708.67. 42,080 parcels registered (45 per cent official). Postal clerks placed on steamers between New York and zone. Money orders for $4,686,684.98 issued. New post-office buildings erected at Cristobal, Culebra, and Ancon.

412 vessels entered at Ancon and Cristobal. No fees.

1,081 leases; revenue, $17,436.76. Distillation, liquor, and bonding fees, $44,743.96. General taxes, $77,467.47

32 estates administered.

Total revenues, $231,666.87.

Police and prisons: 232 men. 6,075 arrests; 4,731 convictions. At end of year 108 felony convicts. Prisoners employed on public improvements; did work to value of $14,856.65.

1,540 writs served in civil cases. 140 deaths investigated. **P-08**, 25, 26.

Schools: 11 places for whites; 15 places for colored children. 721 pupils enrolled in former; 2,146 in latter. New schools completed at various points.

Fire protection: Paid companies organized at Gorgona, Empire, Culebra, and Ancon. Four men to a company. Paid fire company at Cristobal. 18 volunteer companies along the line. Electric-alarm systems installed. 2 tugs equipped for fire protection at Cristobal, Colon, and La Boca. 63 alarms; total loss, $46,170.50. Cooperation with protection service of Colon and Panama.

Public works: Collections from private consumers of water in Panama, $42,568.25; $25,233.90 in Colon. 75 private connections to zone systems; collections, $2,772.37.

Markets: New ones at various points; 8 in operation.

Prosecuting attorney: 366 persons filed against; 192 convicted.

Courts: 17 sessions of supreme court, acting on 11 decisions of the circuit court in 4 criminal and 7 civil cases. In the circuit courts 65 civil cases disposed of out of total of 111 on the docket. In the district courts criminal cases filed against 5,776 persons; all but 25 had been acted on at end of year. 14 civil cases pending at end of year of 433 cases filed.

Zone funds: Expended, $183,601.95; balance, $244,762.31. $47,175.03 was for public works, etc.; $35,749.47 for public schools; $99,673.21 for posts. **P-08**, 26, 27.

1908–1913. (See Civil Administration.)

1914. (See Executive Department.)

Zone, Fault. (See Slides.)

Zone Waterways. (See Waterways, Zone.)

Zürcher, P. (See No. 194, p. 2365 of this Index.)
Geology, Culebra, and Emperador, **P-06***, 162.

PART VI.

TOPICAL INDEX

TO ENGINEERING DATA IN THE REPORTS OF THE CHIEF OF ENGINEERS, U. S. ARMY.

1866–1912.

Plates or Views of Typical Engineering Works, page 2625.

GUIDE TO THE USE OF PART VI.

What is contained in this part.—The various reports of the Chief of Engineers, and of officers of the Corps of Engineers, U. S. Army, embrace, at times, necessary and valuable details or descriptions of engineering work on fortifications, river and harbor works, public buildings, parks, roads, etc. Part VI of this Index is an alphabetical list of the subjects so described, with adequate references, by year and page, to the reports containing the details.

Nature of the details indexed.—Details which consist of but a few lines or words are not, as a rule, indexed in Part VI. The effort has been to list or index details of a more extended character, if especially informative from an engineering viewpoint.

Page and report references.—These are of the same general form as in other parts of the Index. Illustration—**99,** 776, means the annual reports of the Chief of Engineers for 1899, page 776; **03,** S., 309 means the annual reports of the Chief of Engineers for 1903, supplement, page 309. H. D. 479 (or S. D.), 56th, 1st, means House Document No. 479, 56th Congress, 1st session. Some earlier issues of Professional Papers of the Corps of Engineers are referred to as P. P.

Cross references.—In compiling the Topical Index the advantage of logical cross references to main headings has been kept in view; i. e., "Breakwater" refers to many related topics. It has not been felt necessary, however, to provide copious subcross-references to the subjects arranged under a main heading. It is assumed that any person wanting information on, say, breakwaters, would examine, as is customary, each item under that heading and its modifications, making subcross-references unnecessary.

Panama Canal.—Part V of this Index gives the engineering details pertaining to that work, and they are not repeated in Part VI. See page 2357 of this Index.

Timeliness of data.—As it may be difficult for everyone to get access to the earlier reports of the Chief of Engineers, it should be pointed out that references to reports of more recent date throughout Part VI are the more valuable, because, as engineering is a progressive science, the later references generally cover the matter up to date.

PLATES OF TYPICAL ENGINEERING WORKS.

REPORTS, CHIEF OF ENGINEERS, U. S. ARMY, 1866–1912.

Plate and figures.	Construction.	Remarks.
Plate 1:		
A	Breakwater	Outer harbor, Los Angeles, Cal.
B	Breakwater	Extension, Ashtabula, Ohio.
C	Breakwater	Harbor wall, Sandy Bay.
D	Breakwater	Fayerweather Island.
E	Breakwater	View from rubble mound for light at end, Gloucester, showing surface.
F	Breakwater	Surface, Sandy Bay.
Plate 2:		
A	Jetty	Sea side of; reconstruction; cars loaded with rock; rock crane shown.
B	Breakwater	Toro Point, Panama Canal.
C	Breakwater	West breakwater, New Haven, Conn.
Plate 3:		
A	Breakwater	Toro Point, Panama Canal.
B	Breakwater	San Luis, Cal.
C	Breakwater	Unloading rock, Toro Point, Panama Canal.
D	Breakwater	Surface, sea face, and open end of superstructure under construction, Sandy Bay.
Plate 4:		
A	Jetties	View of two, Newburyport.
B	Breakwaters	Harbor face, Gloucester.
C	Breakwater	Rubble mound for light at end, Gloucester.
D	Breakwater	Stonington Harbor, Conn.
Plate 5:		
A	Jetty	South Pass, Mississippi River.
B	Jetty	Siuslaw River.
C	Jetty	Cowlitz River.
D	Dike	Pile dike, Flushing Bay, N. Y.
E	Dam	Wing dam, upper Mississippi River.
F	Harbor	Inner harbor, behind jetties, Grand Marias, Minn.
Plate 6:		
A	Piers	Pier and breakwater construction, Ludington, Mich.
B	Pier	Molding tunnel section, Milwaukee, Wis.
C	Breakwater	Timber crib breakwater, with concrete superstructure.
D	Pier	Sinking caissons, Milwaukee.
E	Breakwater	Duluth-Superior, Minn.
Plate 7:		
A	Breakwater	Crib ready for sinking, Manistee, Mich.
B	Breakwater	Ludington, Mich., sinking crib.
C	Breakwater	Ludington, Mich.
D	Breakwater	Stone breakwater, Buffalo, N. Y.
E	Pier	Winter scene at end of pier, Grand Haven, Mich.
Plate 8:		
A	Pier and dredging	Extending old pier; hydraulic dredging; South Haven, Mich.
B	Breakwater or pier	Sinking first crib, Manistee, Mich.
C	Pier and harbor	Pile revetment; breakwater in background; Keweenaw Waterway.
D	Pier	Driving piles for crib foundation, Ludington, Mich.
Plate 9:		
A	Pier	Concrete superstructure, Milwaukee, Wis.
B	Breakwater	Looking from pier light, Marquette, Mich.
C	Pier and harbor	East and west piers, Ontonagon, Mich.
D	Piers and harbor	Looking toward Lake Superior, past aerial ferry, Duluth-Superior, Wis.
E	Breakwater	Agate Bay, Minn.
Plate 10:		
A	Breakwater	End of main breakwater, timber post in view stands upon pierhead crib just below surface of water, Ashland, Wis.
B	Piers and harbor	Entrance, Grand Marais, Minn.
C	Breakwater	Timber crib breakwater with timber and concrete superstructure, Buffalo, N. Y.
D	Breakwater	Looking toward shore, Marquette Bay (Presque Isle), Mich.

Plate and figures.	Construction.	Remarks.
Plate 11:		
A	Pier	Concrete revetment, looking toward harbor, Superior entry, Duluth-Superior, Minn.
B	Breakwater	Junction of pile pier section and concrete caisson section, Racine, Wis.
C	Piers	Concrete piers, Lorain, Ohio.
D	Piers and breakwaters.	Completed form for reinforced concrete caisson; finished caisson in rear; Milwaukee, Wis.
Plate 12:		
A	Jetty	Reconstruction; making and depositing concrete; Humboldt Bay, Cal.
B	Pier	Beam and floor reinforcement; superstructure; Balboa terminals, Panama Canal.
C	Jetty	Reconstruction; cars loaded with concrete material; railroad ties embedded in concrete; concrete top of jetty; Humboldt Bay, Cal.
D	Jetty	Reconstruction; concreting top; crest of old jetty at low water shown in background; Humboldt Bay, Cal.
Plate 13:		
A	Piles	Concrete piles, casting and aging, Missouri River.
B	Piers	Concrete superstructure center pier, St. Marys Locks and Canal, Mich.
C	Jetty	Pile driver, mouth of Columbia River.
Plate 14:		
A	Dike	Rubblestone dike, across flats; showing spall bed on which rubblestone was laid; Provincetown Harbor.
B	Dike	Concrete pile dike; building forms for concrete bracing work; Missouri River.
C	Jetty	Pile jetty; Cowlitz River.
Plate 15:		
A	Dam or dike	Closing dam across chute, upper Mississippi River.
B	Dike	Building piling or hurdle dike, central rivers.
C	Dike	Wooden pile dike; plant and supervision furnished at private firm's expense.
D	Dike	Rubblestone dike, Provincetown Harbor.
E	Dike	3-row standard dike under construction; land pile driver in operation; Missouri River.
Plate 16:		
A	Dikes	Spur and longitudinal dikes, upper Tennessee River.
B	Dikes	Spur and longitudinal dikes, French Broad River.
C	Dike	Concrete pile dike; dike partly braced; workmen pouring concrete into the forms; Missouri River.
D	Dike	Concrete pile dike, before mattress and bracing in place, Missouri River.
Plate 17:		
A	Barrier or dike	Yuba River, Cal.
B	Dam or hurdle	Closing slough, Mississippi River.
C	Dam	Back channel dam; characteristic of low dam of concrete, Ohio River, Browns Island.
Plate 18:		
A	Dam	Reservoir dam, Winnibigoshish.
B	Dam	Pine River, Reservoir Dam.
C	Dam	Leech Lake Reservoir Dam.
D	Dam	Pokegama Reservoir Dam.
E	Dam	Leech Lake Reservoir Dam.
Plate 19:		
A	Dam	Gull Lake Reservoir Dam.
B	Dam	Winnibigoshish Reservoir Dam.
C	Dam	Gatun Spillway Dam, Panama Canal.
Plate 20:		
A	Dam and water power.	Hales Bar Dam, Tennessee River.
B	Lock and dam	Construction, No. 15, Ohio River.
C	Lock and dam	Concrete on pile foundation, Dam No. 6, Green River, Ky.
Plate 21:		
A	Lock and dam	No. 1, Osage River.
B	Lock and dam	No. 6, Cumberland River.
C	Lock and dam	No. 21, Cumberland River.
D	Lock and dam	No. 1, between Minneapolis and St. Paul, Minn.; construction.
Plate 22:		
A	Dam and waste weir.	At Lock and Dam No. 4, Trinity River, Tex.
B	Dam	No. 3, Muskingum River.
C	Dam, lock, and reservation.	No. 3, Cumberland River.
Plate 23:		
A	Lock and approach	Black Rock, N. Y.
B	Lock chambers	Black Rock, N. Y.; chambers pumped out to level of sill.
C	Locks	Gatun Locks. Steamship Ancon leaving upper west chamber and entering Gatun Lake.

Plate and figures.	Construction.	Remarks.
Plate 24:		
A	Lock	No. 2, Cumberland River.
B	Lock	Model, St. Marys River Locks, Mich., showing culverts, gates open and shut, and form of concrete walls.
C	Lock	Boat passing through Moline Lock, upper Mississippi River.
D	Lock	No. 9, Muskingum River.
Plate 25:		
A	Lock	No. 1, Cumberland River.
B	Lock	No. 5, Cumberland River.
C	Lock and dam	No. 8, Ouachita River.
D	Lock, dam, and reservation.	Yamhill River.
Plate 26:		
A	Lock	Concrete construction, St. Marys River, Mich.
B	Lock	Construction, forms in place for emptying culverts, St. Marys River.
Plate 27:		
A	Lock	Colbert Shoals Canal, Tennessee River.
B	Lock and approach	Bayou Teche.
C	Dam	Sandy Lake Reservoir Dam, upper Mississippi River.
D	Lock and dam	Trinity River, Tex.
Plate 28:		
A	Cofferdam and lock	Lock D, Cumberland River.
B	Lock and dam	No. 6, under construction, Ouachita River.
C	Lock and dam	No. 1, Trinity River, Tex.
Plate 29:		
A	Concrete work	Pouring concrete, quay wall, Balboa Terminal, Panama Canal.
B	Concrete work	Placing, Lock No. 15, Ohio River.
C	Concrete work	Forms for concrete lining, upper chamber, tandem locks, Dalles-Celilo Canal, Columbia River.
Plate 30:		
A	Locks and dams	Construction, Lock and Dam No. 17, Black Warrior River.
Plate 31:		
A	Locks and cofferdam	Steel sheet pile cofferdam, lock, Black Rock, N. Y.; unwatered to 45-foot depth.
B	Locks	Construction, Gatun Locks, Panama Canal.
C	Locks	Construction, St. Marys River, Mich.; showing culvert forms.
Plate 32:		
A	Locks	Guard wall, Lock No. 4, Cumberland River.
B	Locks	Gatun, Panama Canal; Gatum, the first boat through, entering locks, September 26, 1913.
C	Dam	Driving foundation piles for river wall, Dam No. 48, Ohio River.
Plate 33:		
A	Lock gates	Moving wheel and machine, Gatun Locks, Panama Canal.
B	Lock gates	Constructing safety and lower gates, Pedro Miguel, Panama Canal.
C	Lock gates	Boat passing out of Moline Lock, upper Mississippi River.
D	Lock gates	Colbert Shoals Canal, Tennessee River.
Plate 34:		
A	Locks and approach.	Interior view, approach wall, Gatun Locks, Panama Canal.
B	Lock	Gates closed, Schooner Bayou, La.
C	Lock	Steamer about to enter lock, Cascades Canal Lock, Columbia River.
D	Locks and approach.	Flaring approach wall under construction, Gatun, Panama Canal.
Plate 35:		
A	Lock	Colbert Shoals Canal, Tennessee River.
B	Lock	No. 1, Ohio River; 10,000-ton coal fleet passing through under care of tow.
C	Lock	Steamer in lower chamber, Cascades Canal, Columbia River.
Plate 36:		
A	Lock and dam	No. 2, Trinity River, Tex.; ready for erection of gates and Chanoine Dam.
B	Lock and dam	No. 17, Black Warrior River, Ala.; view of part of the construction.
C	Locks	Construction view, Pedro Miguel, Panama Canal.
D	Locks	Construction view, St. Marys River, Mich.
Plate 37:		
A	Locks and culverts	Concrete work, Gatun Locks, Panama Canal.
B	Lock and cofferdam.	Steel-pile cofferdam; lock building, Cape Fear River, N. C.
C	Lock	Upper end, No. 19, Ohio River.
D	Lock approach walls	Placing deck load on crib of center pier, St. Marys River, Mich.
Plate 38:		
A	Lock	Third lock; construction, St. Marys River, Mich.

Plate and figures.	Construction.	Remarks.
Plate 39:		
A	Locks	Monolithic center wall, with pipe, Gatun, Panama Canal.
B	Lock and cofferdam.	No. 3, Ouachita River; cofferdam flooded.
C	Lock	No. 2, Monongahela River; double locks; construction.
D	Locks	Showing intermediate and lower chambers, Gatun, Panama Canal.
E	Dry dock	At Lock No. 6, Muscle Shoals Canal, Tennessee River.
Plate 40:		
A	Lock gates	Upper guard gates, Gatun, Panama Canal, under erection.
B	Locks	Lower gates and temporary operating house, Black Rock, N. Y.
C	Lock gates	Various gates, Gatun, Panama Canal, under erection.
Plate 41:		
A	Lock site	Beginning construction, Gatun, Panama Canal.
B	Locks	Construction, Pedro Miguel, Panama Canal.
C	Lock	Construction, No. 19, Ohio River.
Plate 42:		
A	Dam, movable	No. 18, Ohio River.
B	Dam, movable	No. 1, Allegheny River; bear trap dam raised.
C	Dam, movable	No. 1, Allegheny River; bear traps lowered.
D	Dam, movable	No. 26, Ohio River; placing wickets, navigable pass.
Plate 43:		
A	Dam, movable	No. 18, Ohio River; wickets up.
B	Dam, movable	No. 1, Ohio River; raising Chanoine wickets.
C	Dam, movable	No. 41, Ohio River; Boule section.
D	Dam, movable	No. 4, Ohio River; Chanoine wickets up.
Plate 44:		
A	Dam, emergency	Gatun Locks, Panama Canal; ready to swing across lock.
B	Dam, emergency	Operating machinery, St. Marys River, Mich.
C	Dam, emergency	Gatun Locks, Panama Canal; dam lowered in lock.
D	Dam, emergency	Gatun Locks, Panama Canal; east emergency dam subjected to head of 50 feet of water, May 6, 1914.
E	Dam, emergency	Lowering wickets, St. Marys River, Mich.
Plate 45:		
A	Canal	West Neebish rock cut, St. Marys River Canal, Mich.
B	Canal	Completed section, Dalles-Celilo, Columbia River.
C	Canal	Completed section, Dalles-Celilo, Columbia River.
D	Canal or waterway	Clearing right of way through swamp, inland waterway, Pamlico Sound to Beaufort Inlet, N. C.
E	Canal	Excavation, Panama Canal.
Plate 46:		
A	Cranes	Unloading sand, Panama Canal.
B	Excavation	Rock excavated to natural slope, by steam shovels, Balboa Terminals, Panama Canal.
C	Quarrying	Loading rock on cars, Toro Point quarry, Panama Canal.
D	Excavation	Lock site, Gatun, Panama Canal.
E	Rockwork	Rock car used in construction of jetties, Columbia River mouth.
Plate 47:		
A	Excavation	Culebra Cut, between Gold and Contractors Hills, Panama Canal, 1890, looking south.
B	Excavation	Culebra Cut, looking north from Contractors Hill, Dec. 28, 1907.
C	Excavation	Culebra Cut, looking south from Contractors Hill (excavation completed south of Cucaracha slide), July 19, 1913.
Plate 48:		
A	Canal slides	Culebra Cut, Cucaracha, looking north from west bank, Dec. 9, 1913; dredges operating.
B	Canal slides	Culebra Cut, Culebra, Panama Canal; blasting channel through Cucaracha slide, looking north, Oct. 16, 1913
C	Canal slides	Culebra Cut, Culebra, Panama Canal; looking south from top of Contractors Hill, Cucaracha slide to the left, Dec. 3, 1913.
D	Canal slide	Rock slide, Panama Canal; excavator smothered.
Plate 49:		
A	Canal excavation	Canal trunk excavated in solid rock, Dalles-Celilo Canal, Columbia River; steam-shovel work.
B	Lock excavation	Rock excavation, by derricks, Dalles-Celilo Canal, Columbia River
C	Canal excavation	Deepest cut, Panama Canal, Culebra Cut.
Plate 50:		
A	Excavation, hydraulic.	Stripping hill, Panama Canal.
B	Excavation	Steam shovel on skids, tunnel work, Panama Canal.
C	Rock blasting	Charge of dynamite fired from 25 holes, Willamette River.
Plate 51:		
A	Excavation	Pipe line dredge working below Keokuk, Iowa, upper Mississippi River.
B	Excavation	Hydraulic dredging, suspended or fixed pipe line, San Pablo Bay, Cal.
C	Excavation rock	Drill rafter and tender, with drills at work, Tuscambia Bar, Tennessee River.
D	Excavation	Floating pipe-line arrangement, hydraulic dredging, San Pablo Bay, Cal.

Plate and figures.	Construction.	Remarks.
Plate 52:		
A	Dredging	20-inch suction dredge with ponton pipe or discharge line at work, Oakland Harbor, Cal.
B	Dredging	United States pump boat working, Savannah River, below Augusta, Ga.
C	Dredging	Dredging and disposal of material ashore, inland waterway, Pamlico Sound to Beaufort Inlet, N. C.
Plate 53:		
A	Dredge	Burton.
B	Dredge	Pipe-line dredge Morgan, used to rehandle dumped material from sea goers in specially prepared pockets.
C	Dredge	Pump boat Augusta, showing cutter, and A frame.
D	Dredge	Savannah, running light.
E	Dredge	Atlantic.
F	Dredgings	Extension of Governors Island, New York Harbor, from dredgings, etc.
Plate 54:		
A	Dredge	New Orleans.
B	Dredge	New Orleans.
C	Dredge	Tennessee working on Tuscambia Bar, Tennessee River.
D	Snag boat	Dredging shoal, Yazoo River.
E	Dredge	Dipper dredge Ohio.
Plate 55:		
A	Dredge	Savannah loaded.
B	Dredge	Dipper dredge Cheraw removing hard material, Winyah Bay, S. C.
C	Derrick boat	Removing rock shoals, Ocmulgee River, vicinity of Hawkinsville; rock is first blasted, then handled with orange-peel bucket; dump shown in background.
D	Dredge and pipe line	Dredge, floating pipe line, and trestle pipe line, Oakland Harbor, Cal.
E	Dredge	Clatsop.
Plate 56:		
A	Dredge	Alabama working at head of canal, above Lock No. 1, Muscle Shoals Canal, Tennessee River.
B	Snag boat	Macomb, Mississippi River.
C	Snagging plant	Towboat Iroquois and derrick boat Mingot, Ohio River.
D	Snagging	Tree withdrawn from waterways, central rivers.
Plate 57:		
A	Revetment and banks.	Hydraulic bank grading, for revetment, Bates Island Bend, Missouri River.
B	Bank work	Protection, front of Augusta, Ga., showing pavement, sub and top.
C	River floating plant.	Portion shown, Mississippi River.
D	Revetment and banks.	Bank slopes, Mississippi River.
E	Banks	Paving, Savannah River at Augusta, Ga.; plant used to excavate trench at toe of slope; method of handling rock to fill same.
Plate 58:		
A	Revetment and banks.	Standard, 1899; Pelican Bend, Missouri River.
B	Barge	Material barge construction, United States engineer depot, Mississippi River.
C	Banks	Paving, Mississippi River.
D	Banks	Paving with stone, Mississippi River.
Plate 59:		
A	Quarter boat	For employees, Mississippi River Commission, Mississippi River.
B	Banks	Rubble slope lining, gravel section, Dalles-Celilo Canal, Columbia River.
C	Banks	Placing concrete slope lining, gravel section, Dalles-Celilo Canal, Columbia River.
D	Banks	Paving; placing reinforced concrete, Arkansas River.
Plate 60:		
A	Paving	Slope, Gatun Lake, Panama Canal, Gatun Dam.
B	Banks	Ice piled in bends, Mississippi River.
C	Bank and shore	Protection, upper Mississippi River.
D	Banks	Concrete bank paving, reinforced, Arkansas River.
E	Revetment	Finished revetment of concrete pavement and willow mattresses, Missouri River.
Plate 61:		
A	Revetment	Mattress weaving, beginning stitch, Missouri River; hydraulic grading in background.
B	Revetment	Mattress weaving, near Sioux City, Iowa, Missouri River.
C	Revetment	Mattress weaving on ice, Missouri River, Williston, N. Dak.
D	Revetment	Mattress weaving; preparations for sinking mattresses, Mississippi River.
Plate 62:		
A	Revetment	Framed mattress for river revetment ready to be sunk, Mississippi River.
B	Revetment	Sinking mattress, Mississippi River
C	Revetment	Brush and pole mattress work, Trinity Bend, Arkansas River.
D	Revetment	Making mattress, Mississippi River.
E	Revetment	Brush and pole mattress work, Trinity Bend, Arkansas River.

Plate and figures.	Construction.	Remarks.
Plate 63:		
A	Dike breaking	Opening valves in Gamboa Dike, Panama Canal, to flood Culebra Cut: dike to be blasted later.
B	Cave-ins or crevasses	Crevasse narrowly averted; levees 16 feet high, Mississippi River.
C	Floods	Town flooded, Mississippi River.
Plate 64:		
A and B	Floods and levees	Repairing, Mississippi River.
C	Floods and levees	Reinforcing, Mississippi River.
D	Floods and levees	Repairing, Mississippi River.
Plate 65:		
A	Levees	Protection by sand bags, Mississippi River.
B	Flood and shoal	Sand and gravel after flood, Chagres River, Panama Canal; dredging.
C	Crevasse and flood	Cave-in narrowly averted, Mississippi River.
Plate 66:		
A	Bridges	Concrete bridge, Yellowstone Park.
B	Bridges	Concrete bridge, Mandingo River, Panama Canal.
C	Bridges	Inlet bridge, Tidal Basin, District of Columbia.
D	Bridges	Concrete bridge, Yellowstone Park.
E	Bridge, ponton	Panama Canal, Paraiso.
Plate 67:		
A	Roads	Tropical road, Philippines.
B	Roads	Mountain road and wall, Yellowstone Park.
C	Viaduct	Golden Gate Viaduct, Yellowstone Park.
Plate 68:		
A	Monument erection	Stephenson Monument, Washington, D. C.
B	Municipal work	Ancon, P. C.: water reservoir in foreground.
C	Public grounds	Sherman Plaza and Washington Monument.
Plate 69:		
A	Monument erection	Sheridan Statue, Washington, D. C.
B	Monument erection	Washington Memorial Arch, Valley Forge, Pa.
Plate 70:		
A	Buildings	Lock houses, Cumberland River.
B	Buildings	Executive Office, White House, Washington, D. C.
C	Buildings	Lock keeper's dwelling, Cape Fear River.
D	Buildings	Dynamite storage magazines, Panama Canal.
E	Towers	Range towers, Panama Canal.
F	Steel buildings	Government Printing Office, Washington, D. C.
Plate 71:		
A	Lighthouses or range towers.	Panama Canal.
B	Power station	Gatehouse, Gatun, Panama Canal: hydroelectric station.
C	Beacons	Culebra Cut, Panama Canal.
D	Schoolhouses	Culebra, Panama Canal.
E	Buildings	Administration building, Balboa Heights, Panama Canal.
F	Power house	Reinforced-concrete power house, Miraflores, Panama Canal.
Plate 72:		
A	Gauging and river hydraulics.	Station and method, streams of Isthmian Canal Zone, Panama Canal.
B	Meteorology	Fluviograph station, Chagres River, Panama Canal.
C	Soundings	Catamaran, Great Lakes.

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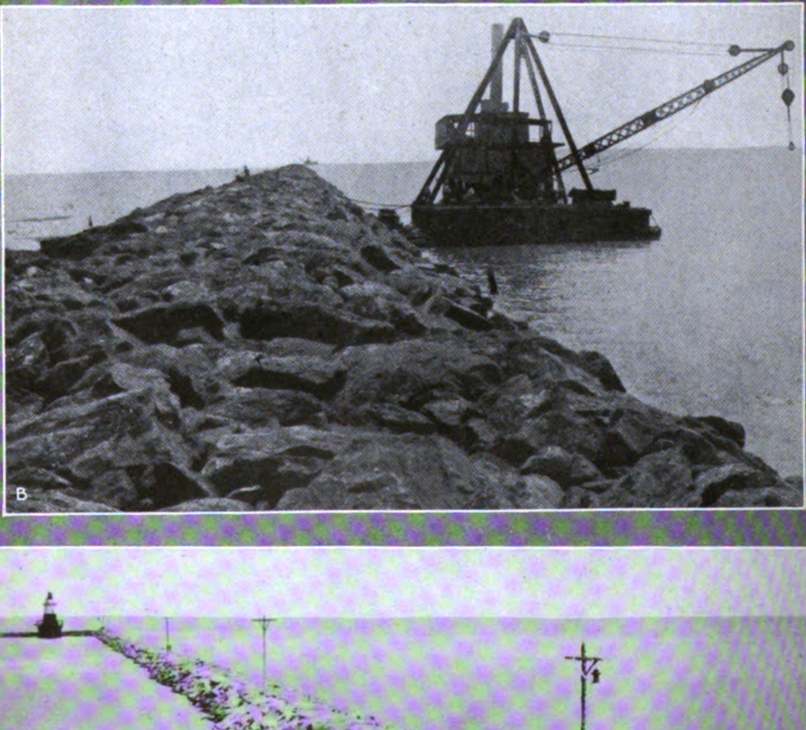

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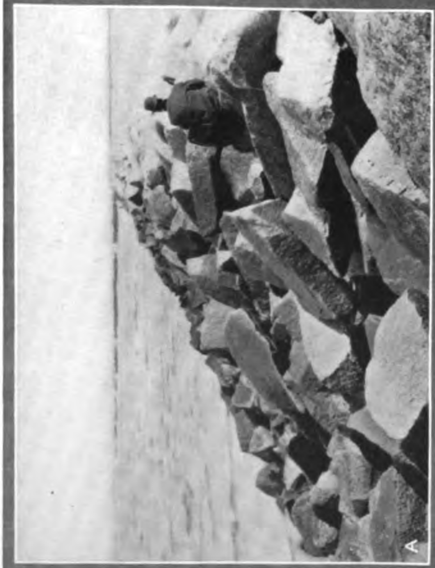

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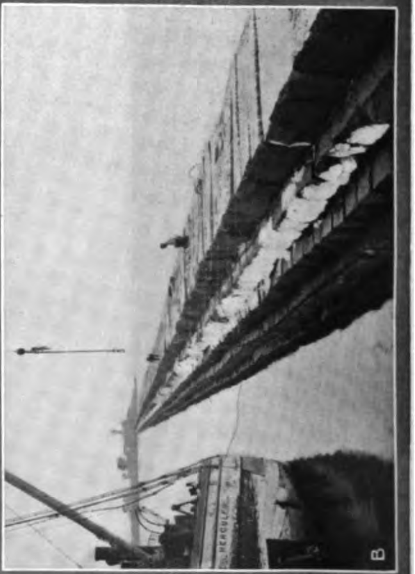

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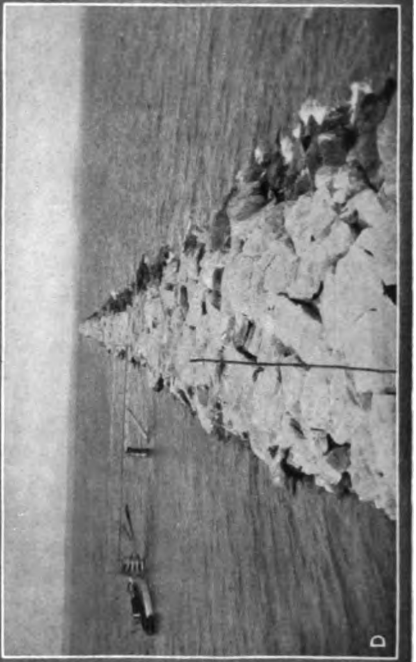

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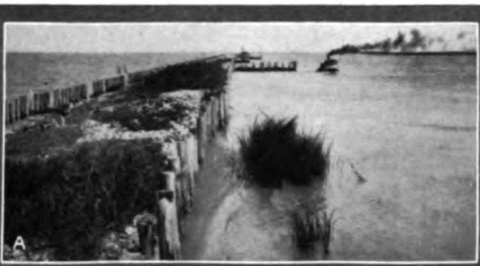
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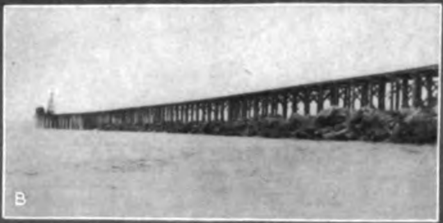
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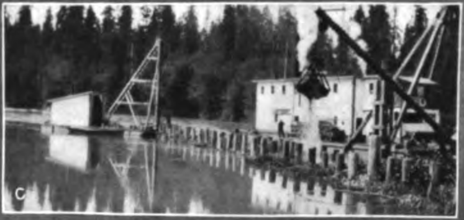
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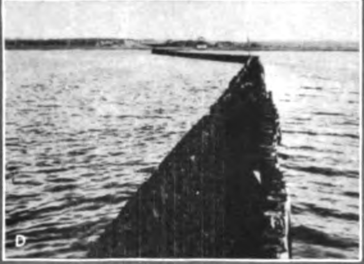
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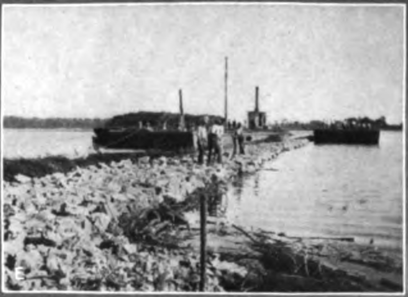
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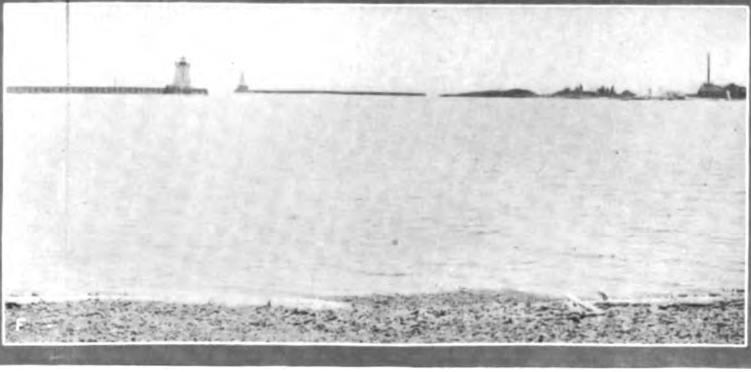
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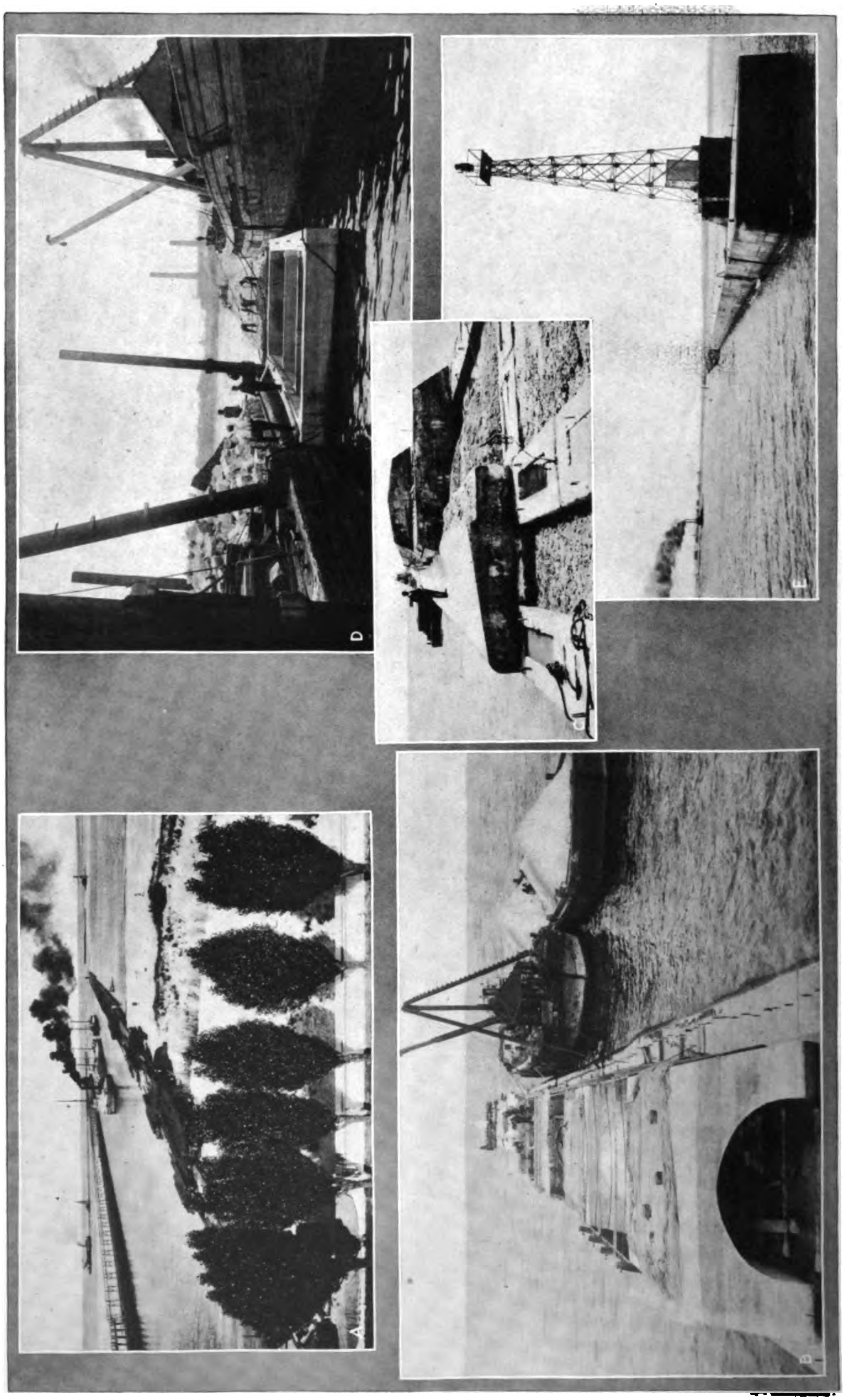

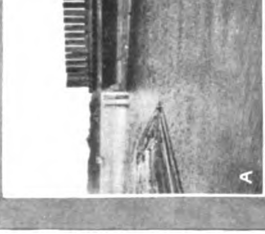
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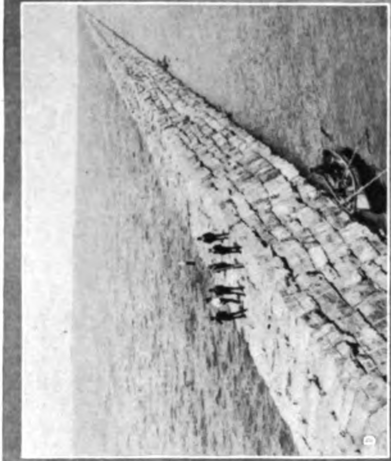
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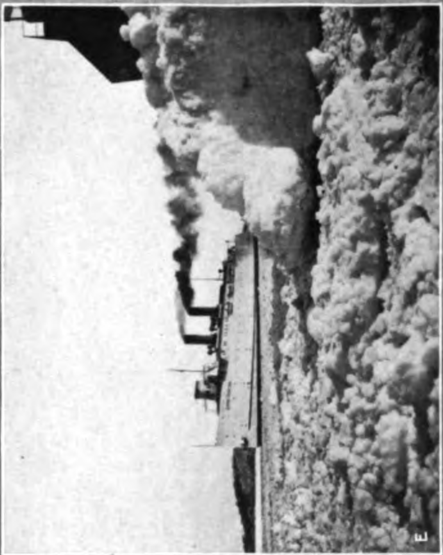
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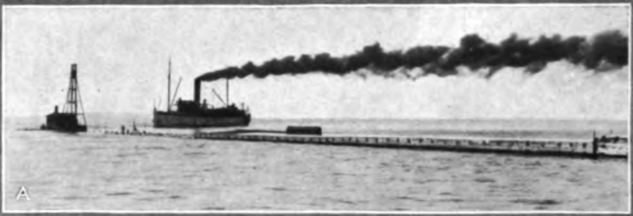
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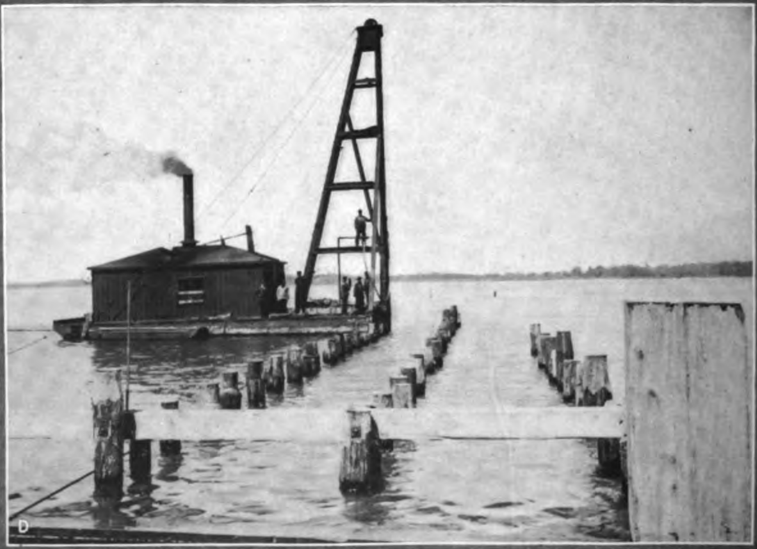
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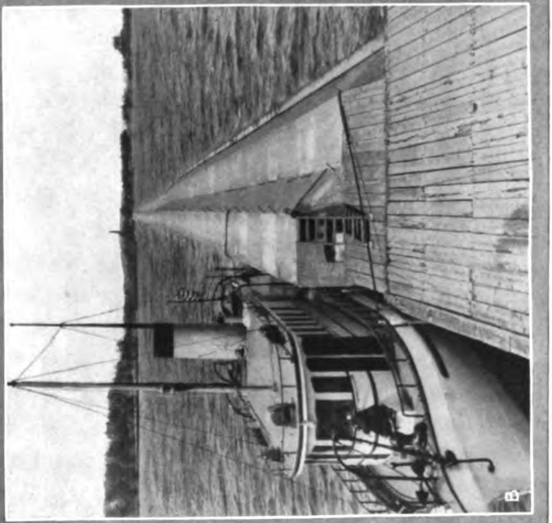
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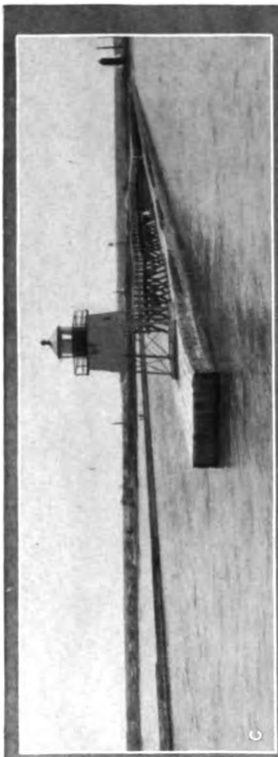
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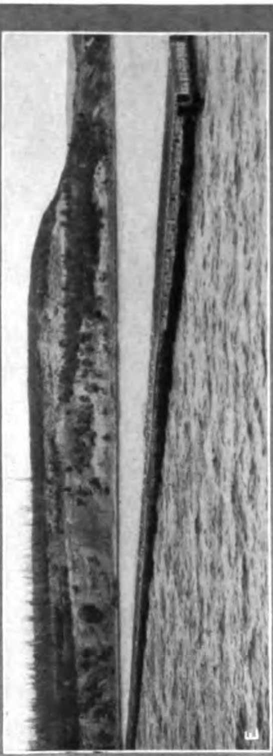
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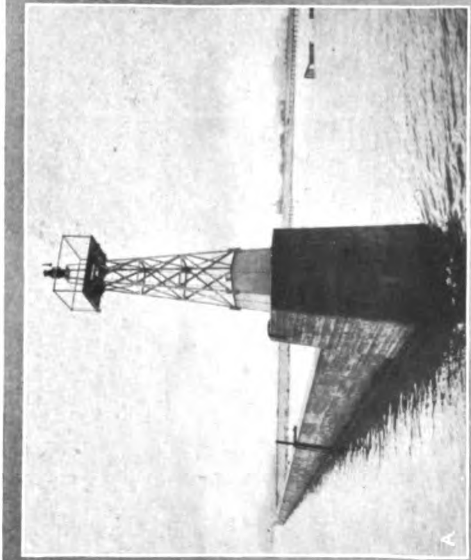
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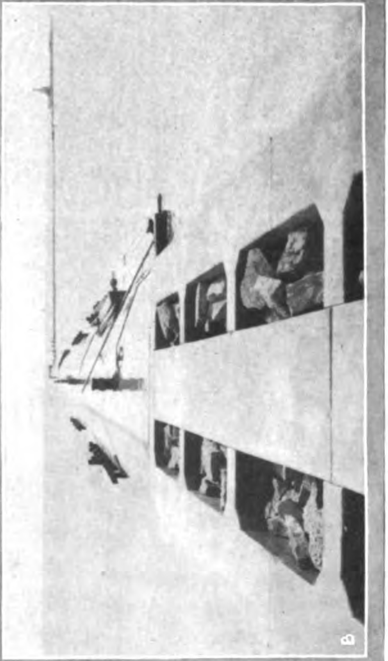
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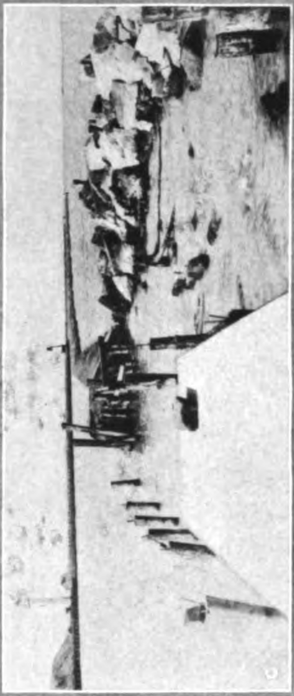
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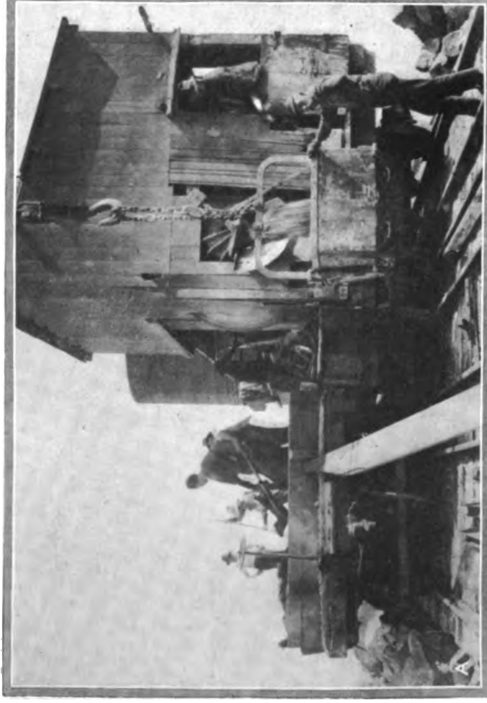
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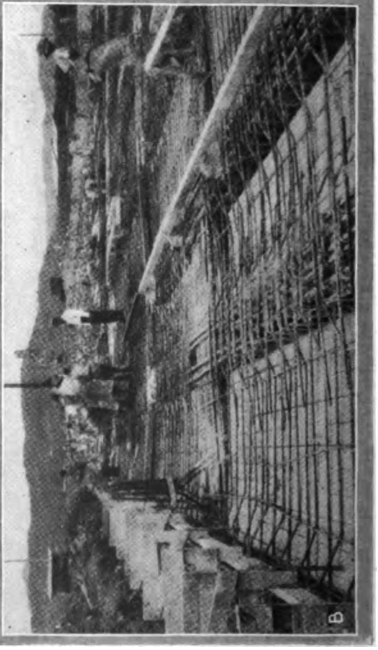
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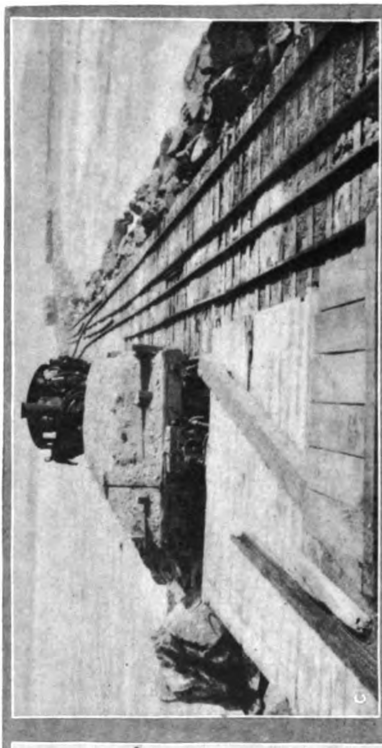
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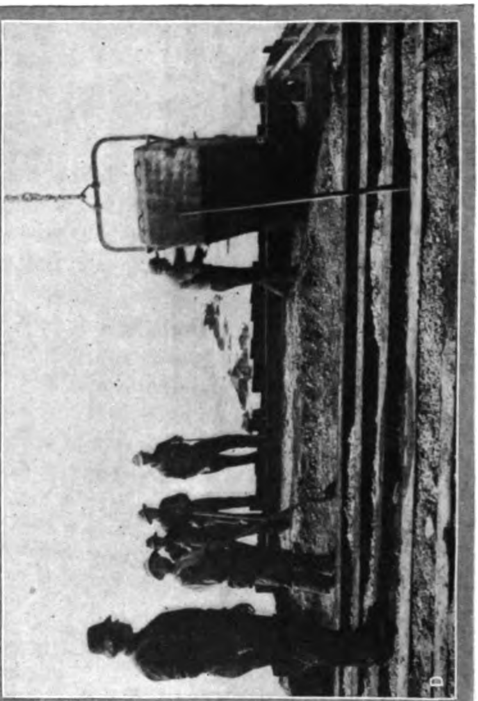
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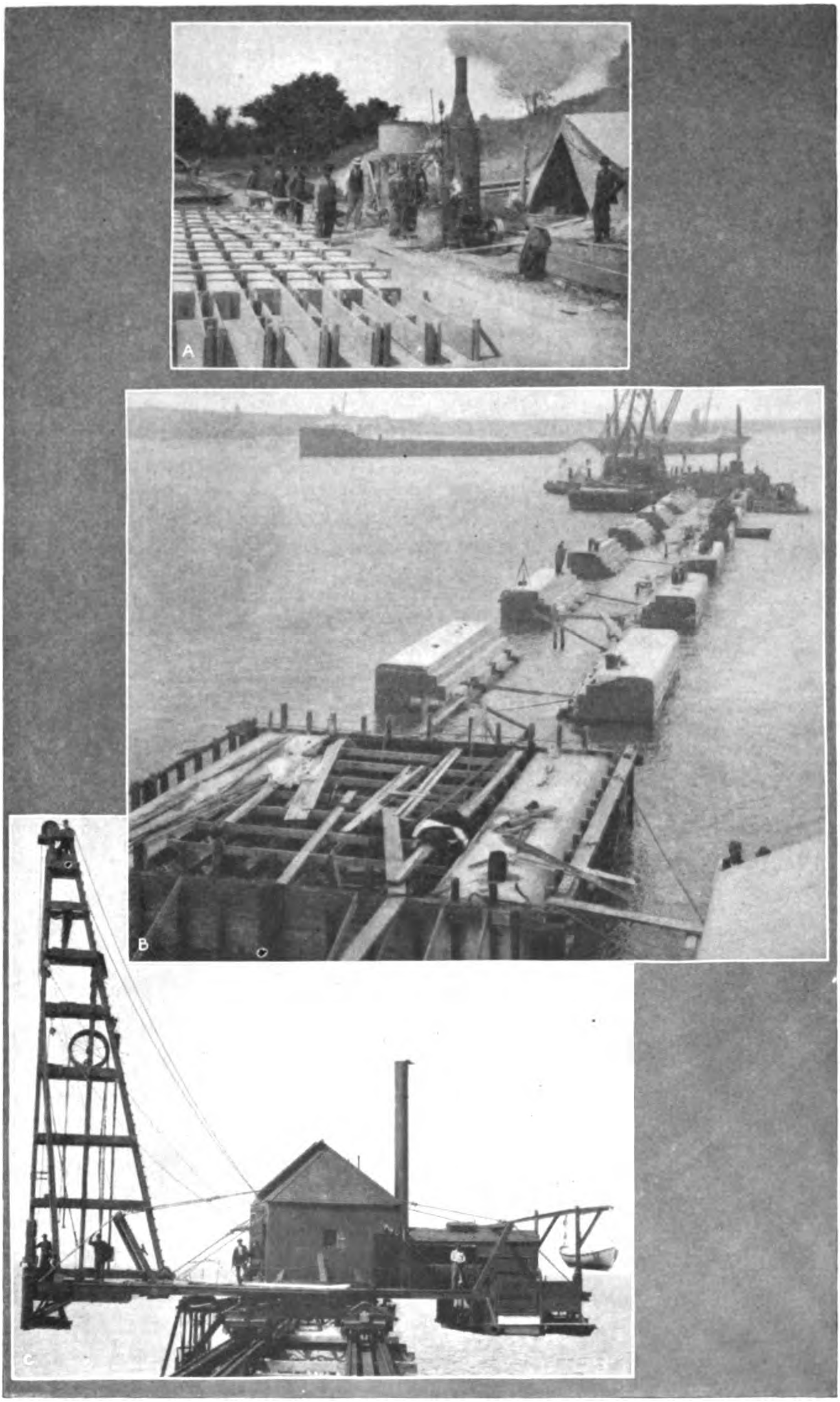
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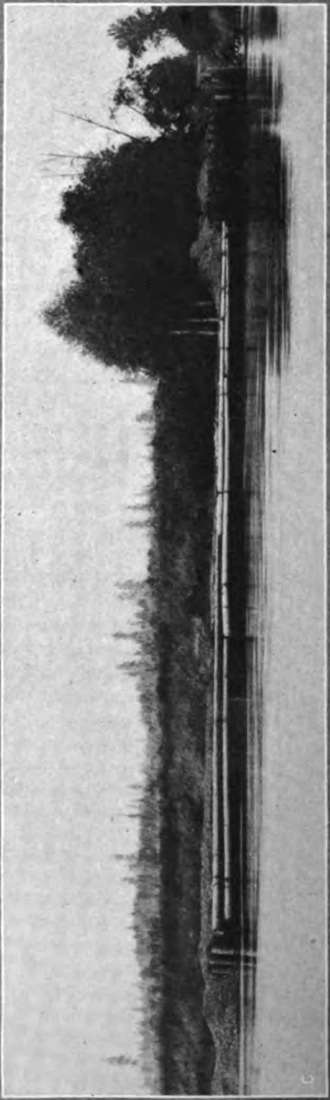
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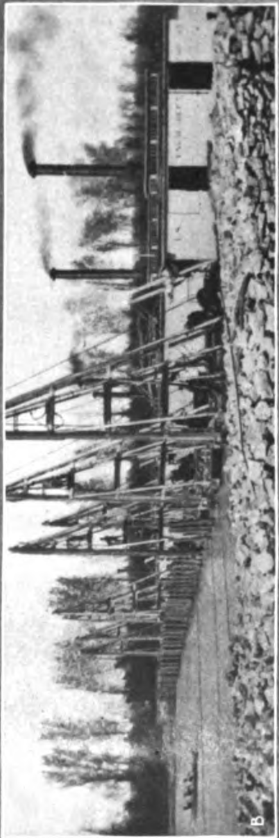
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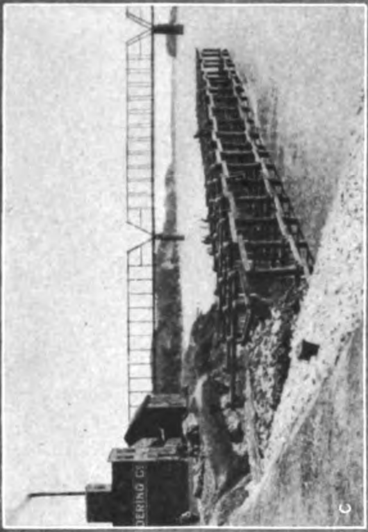
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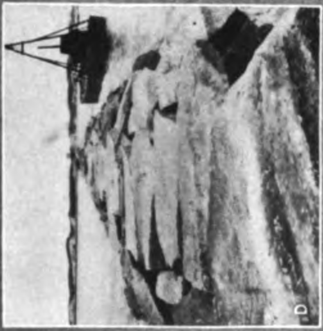
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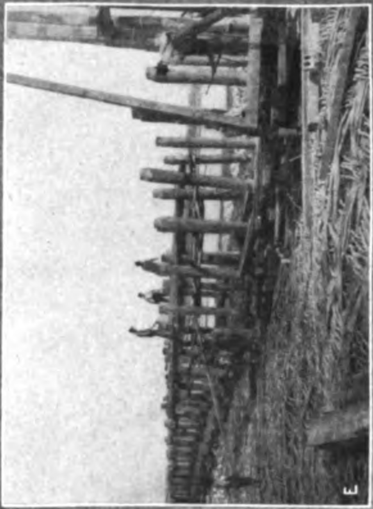
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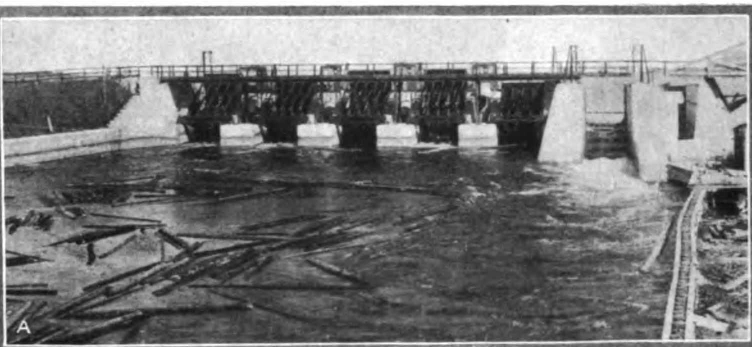
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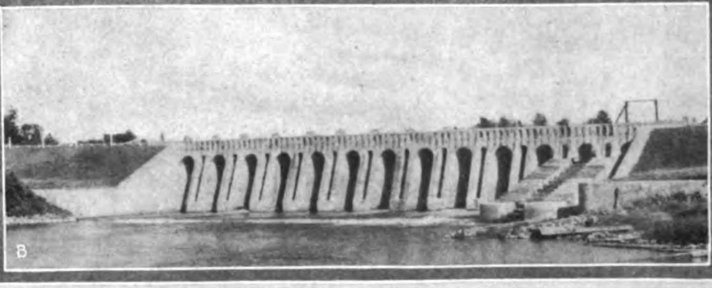
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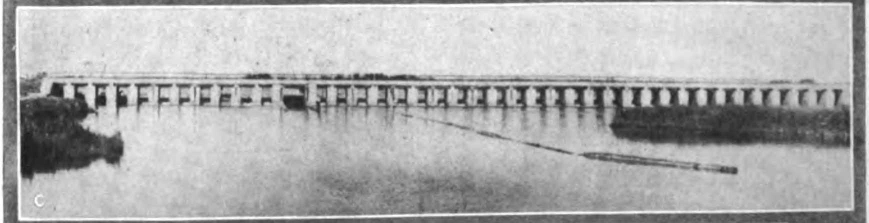
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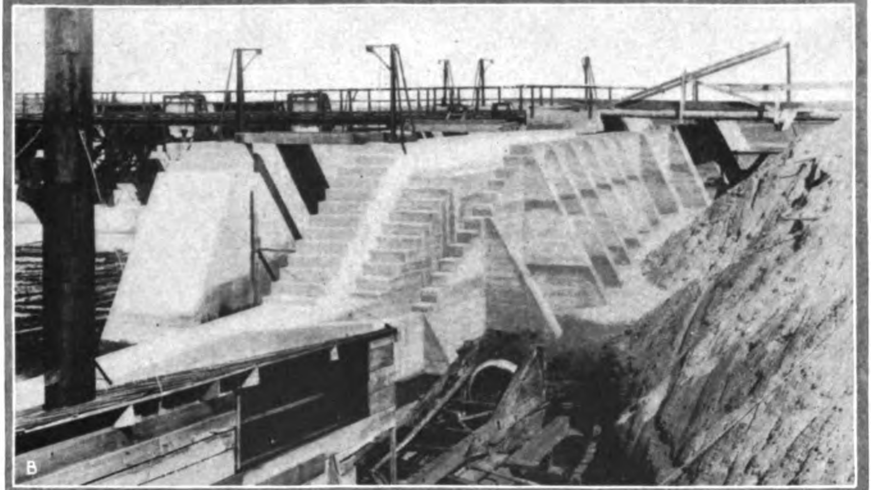
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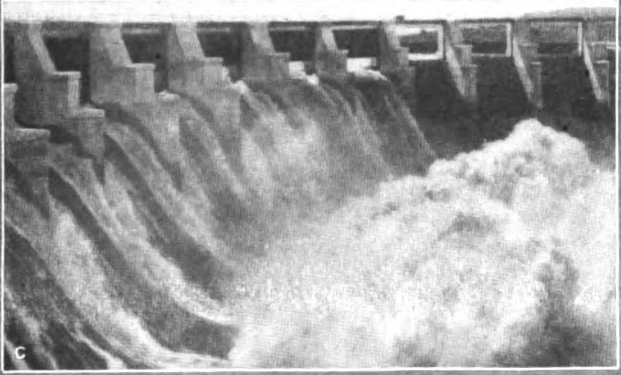
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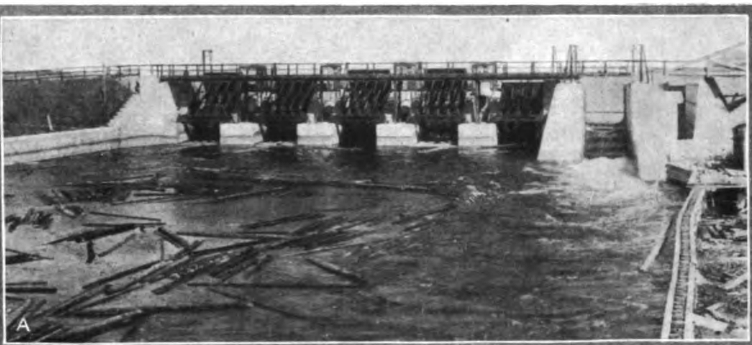

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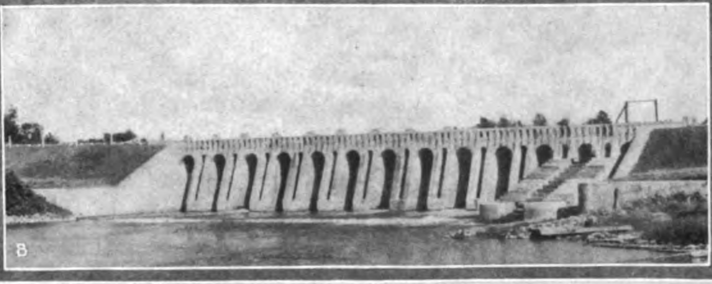

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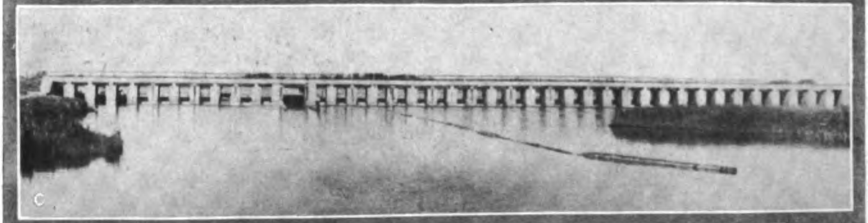

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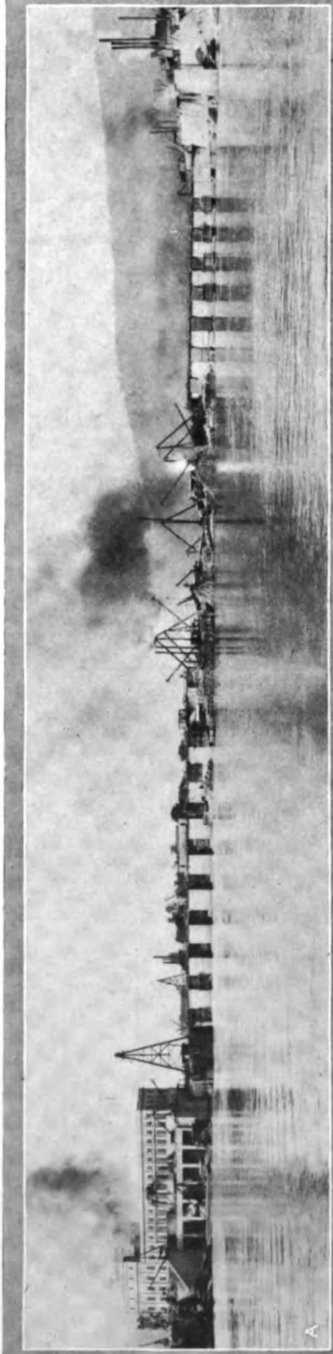

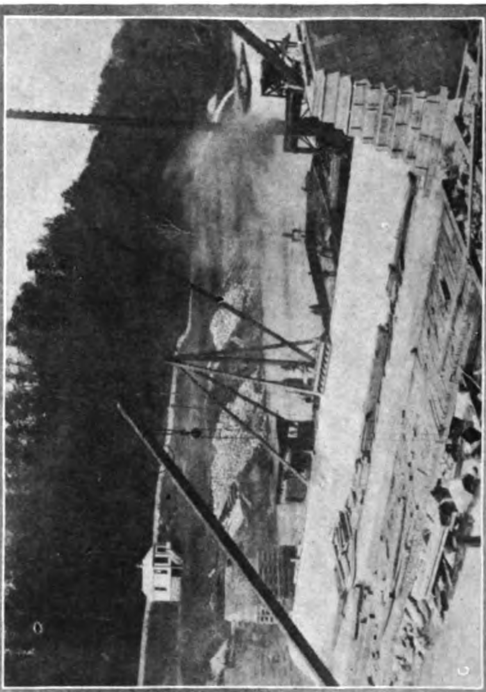

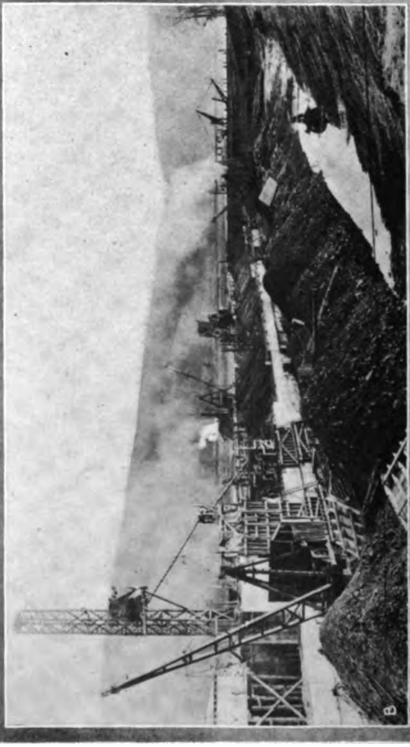

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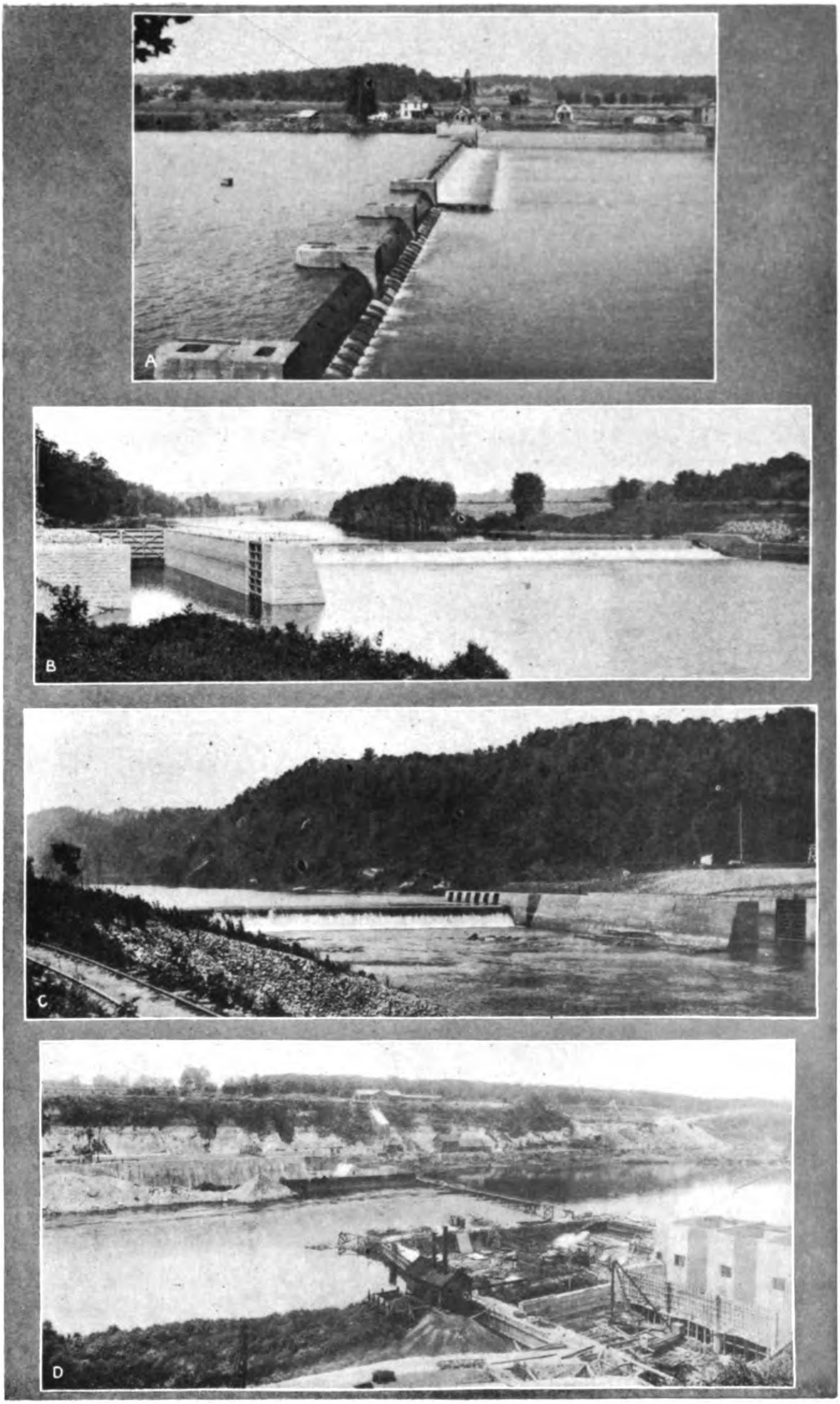

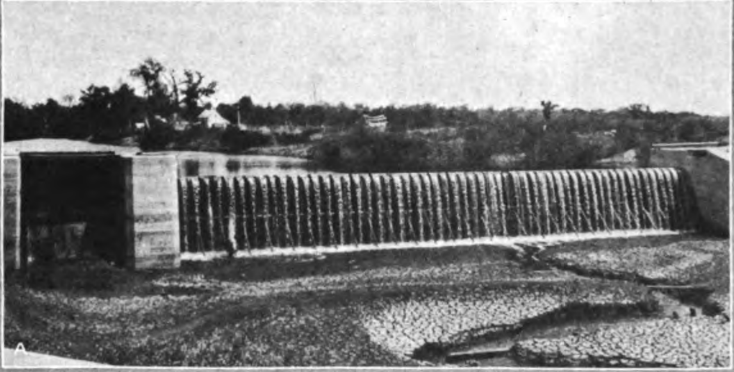
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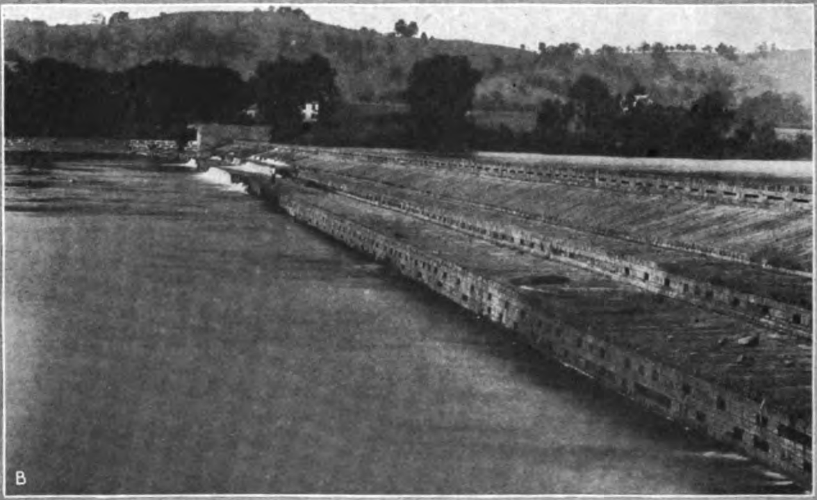
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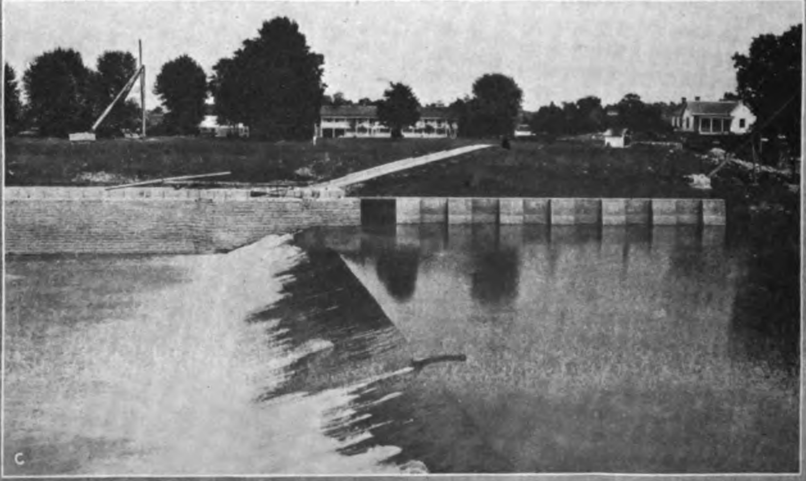
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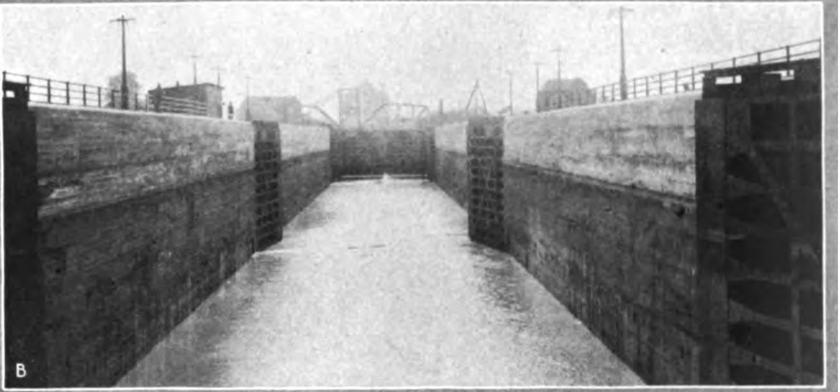

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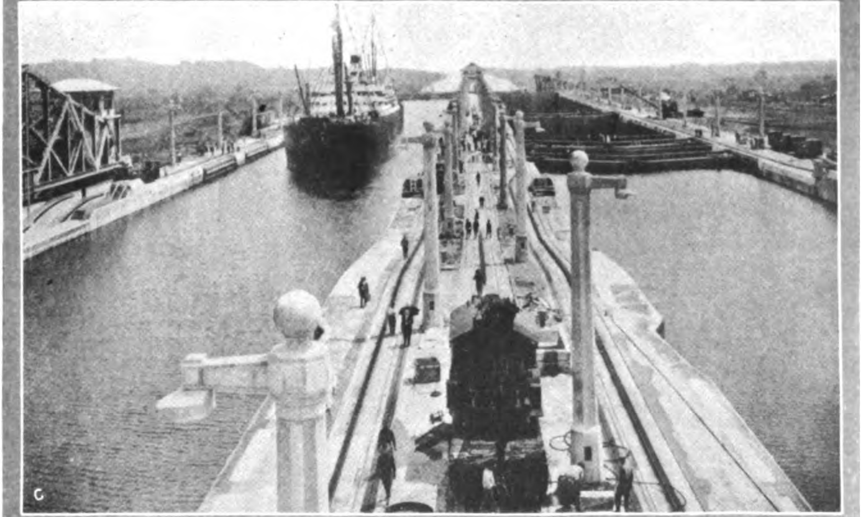

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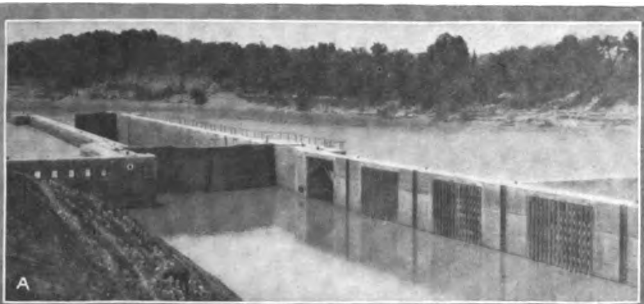
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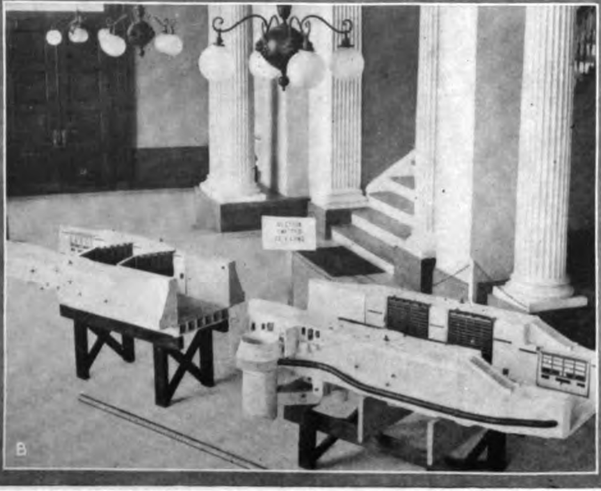
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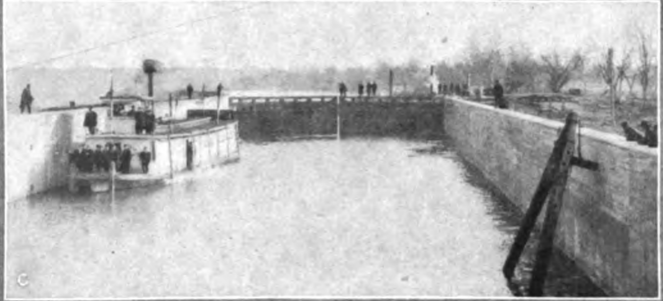
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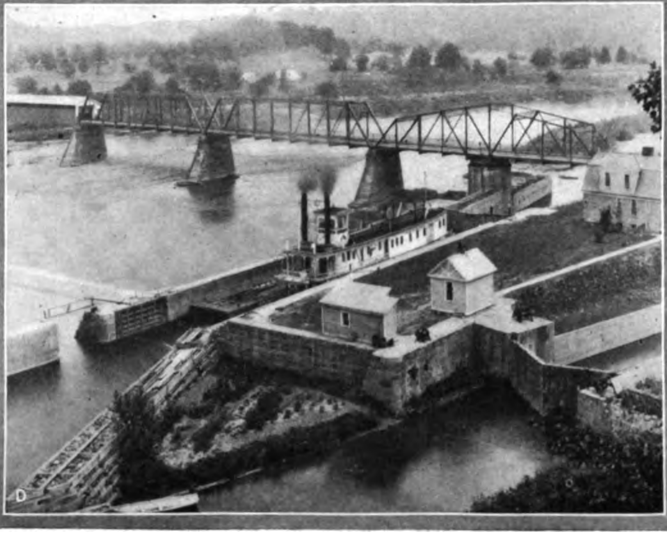
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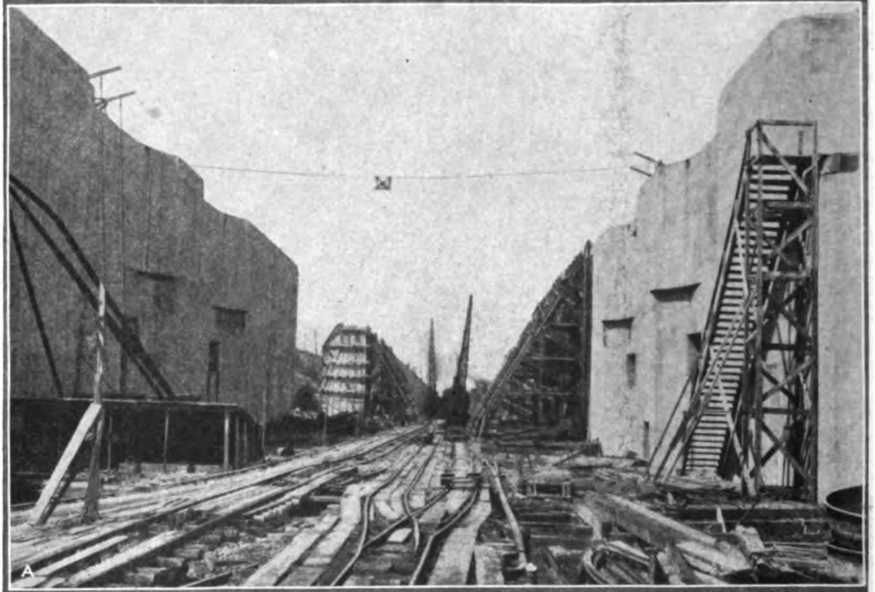
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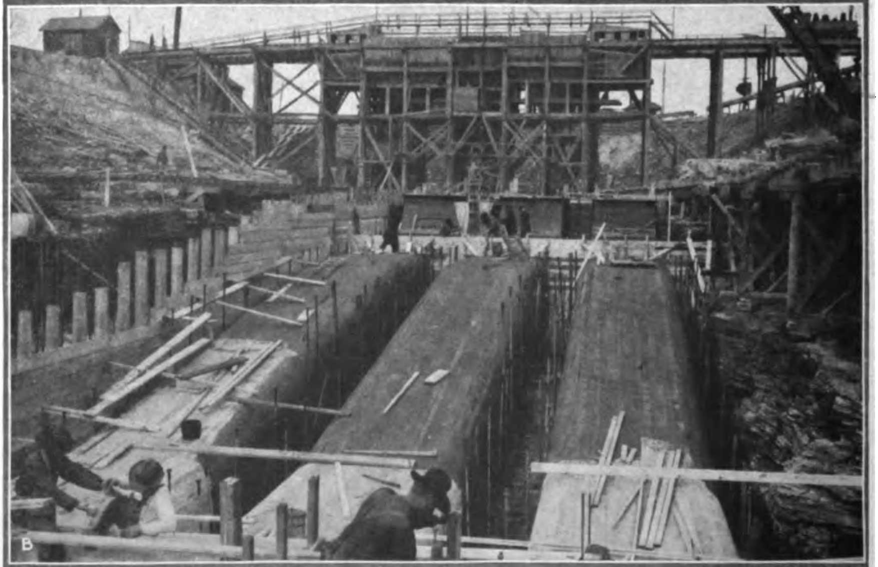
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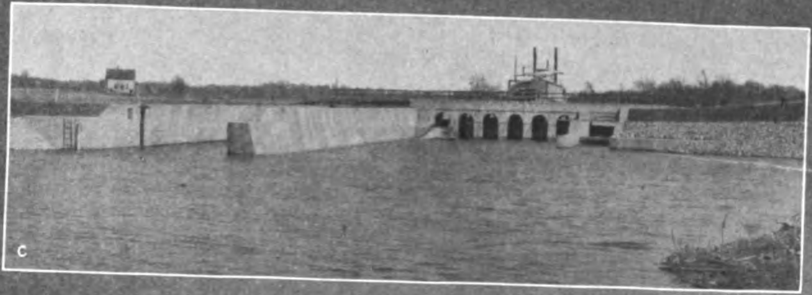
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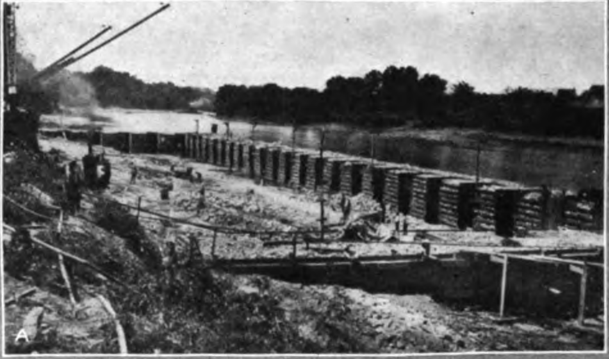
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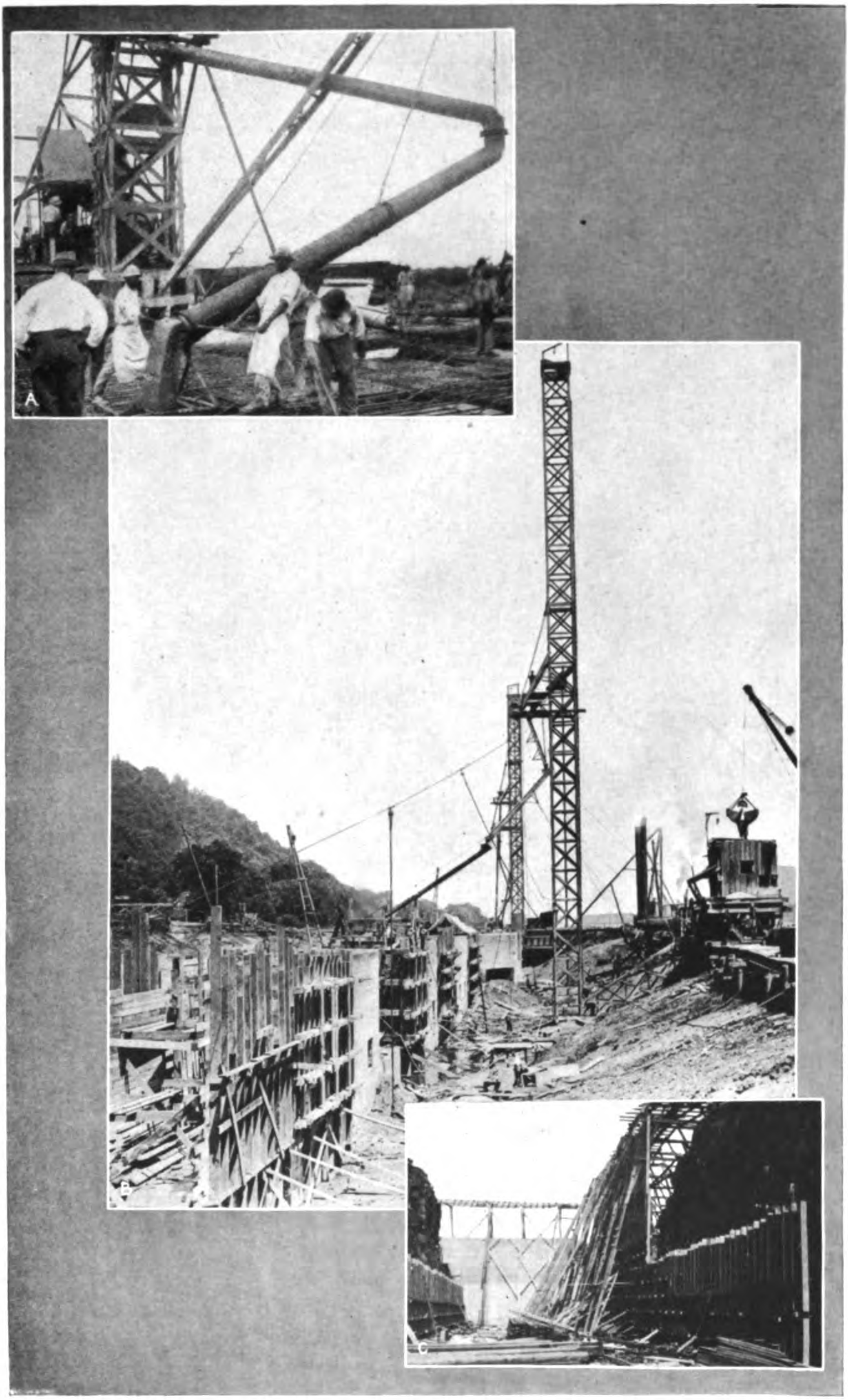
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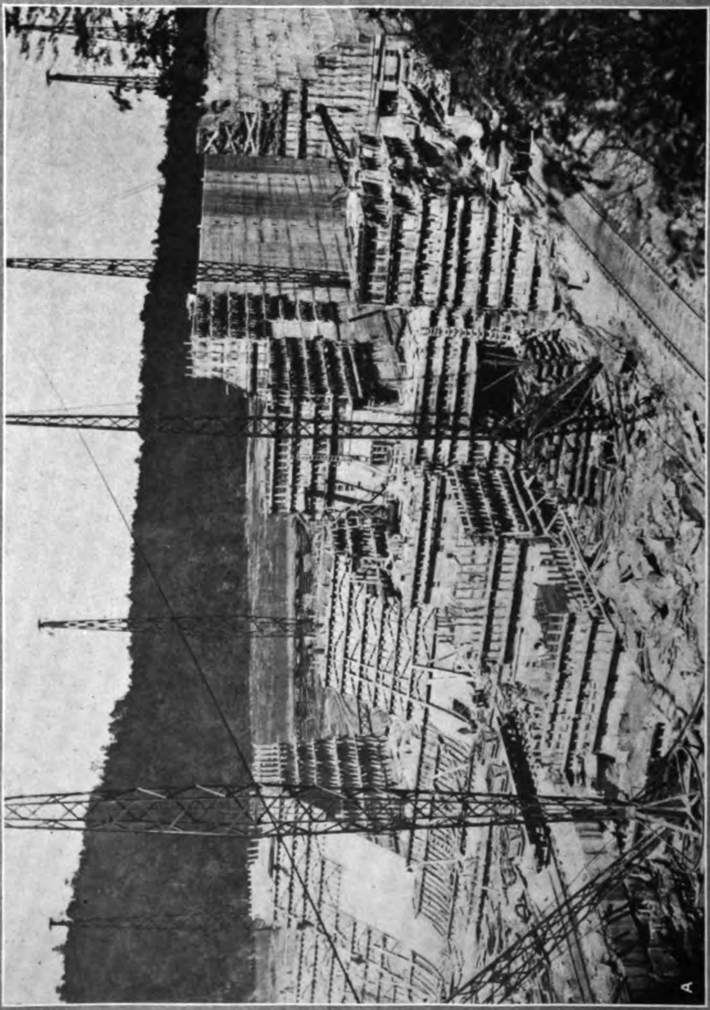
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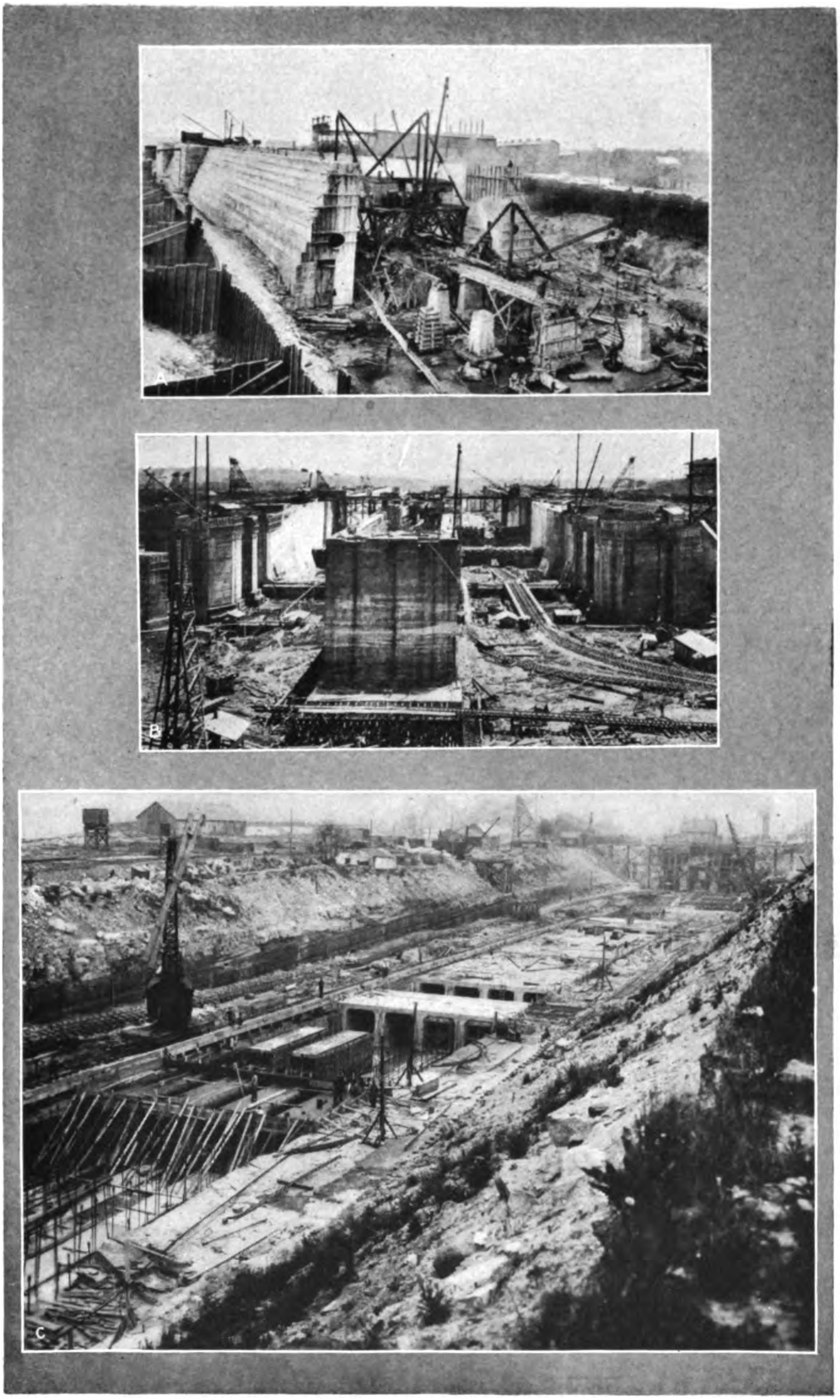
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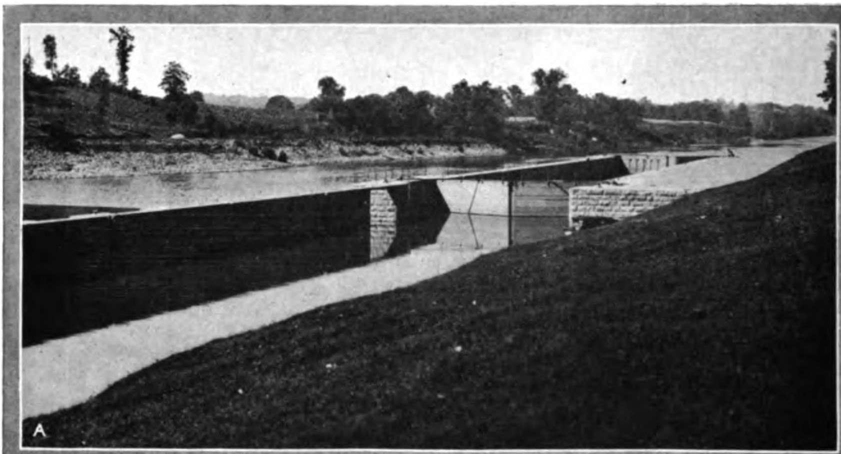
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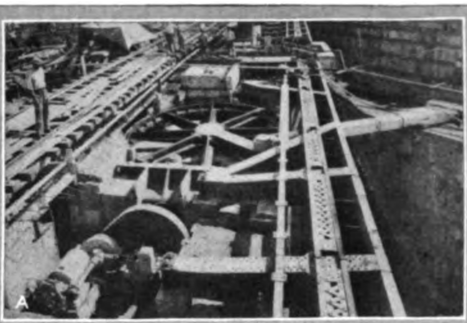
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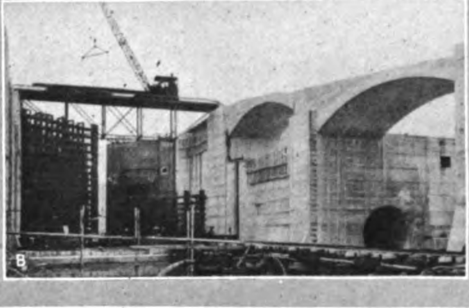
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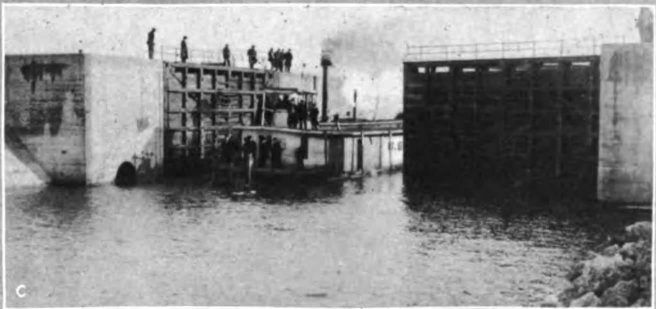
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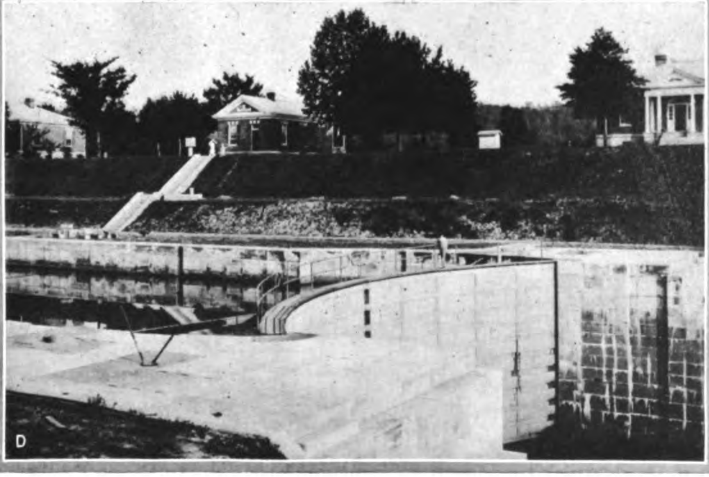
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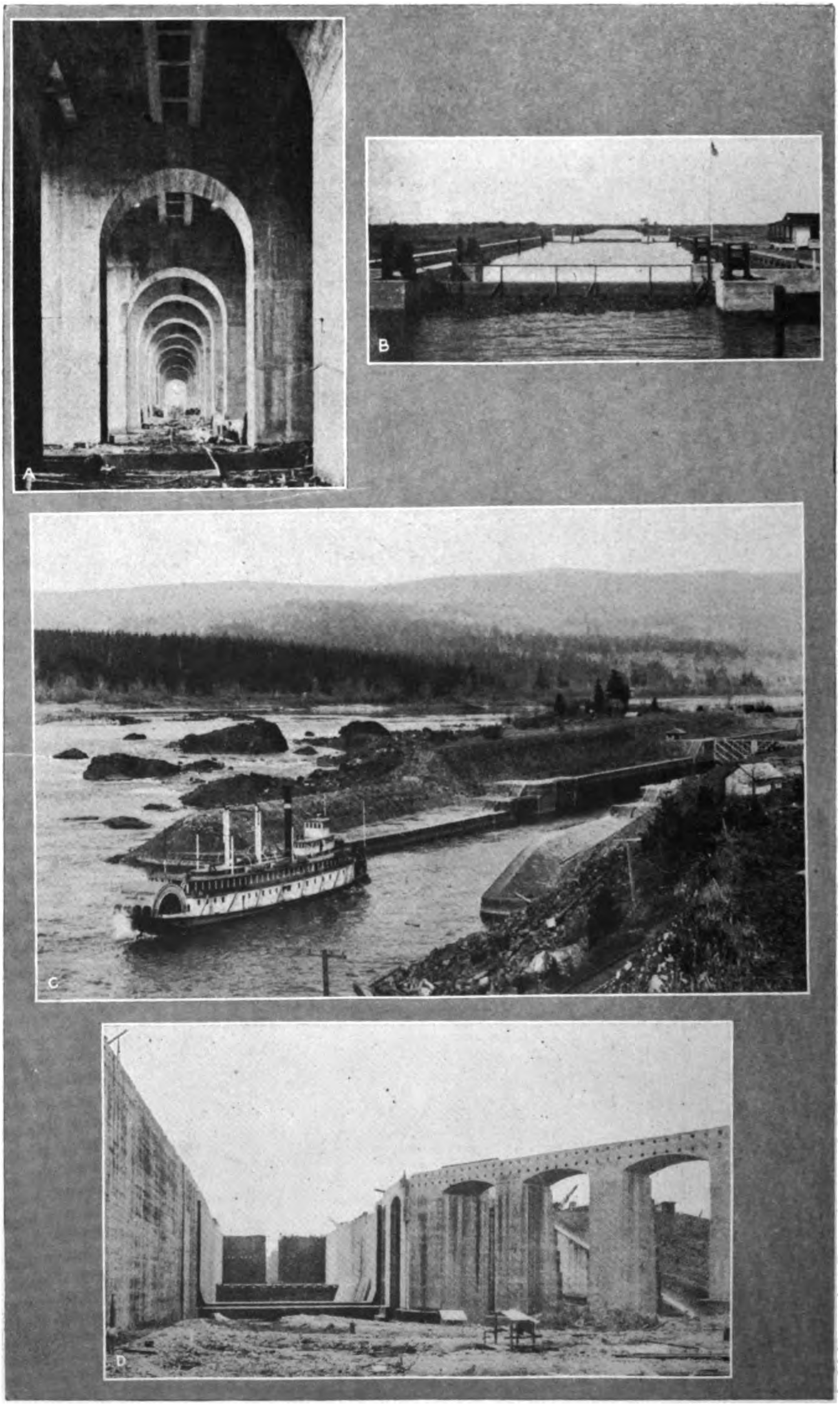
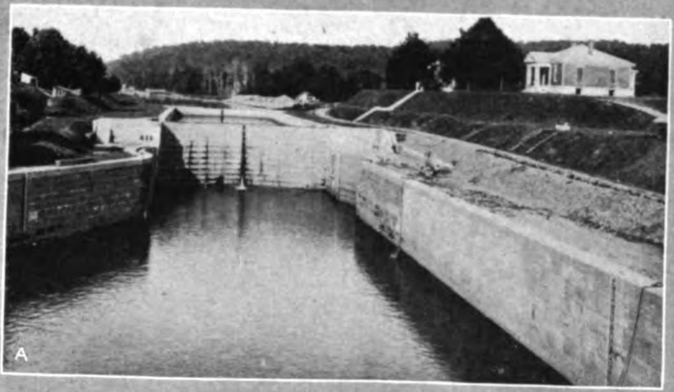
Part VI. Plate 34.

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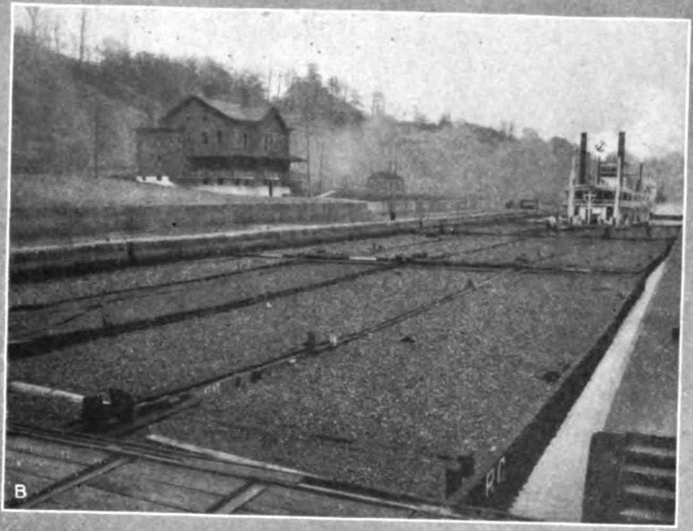
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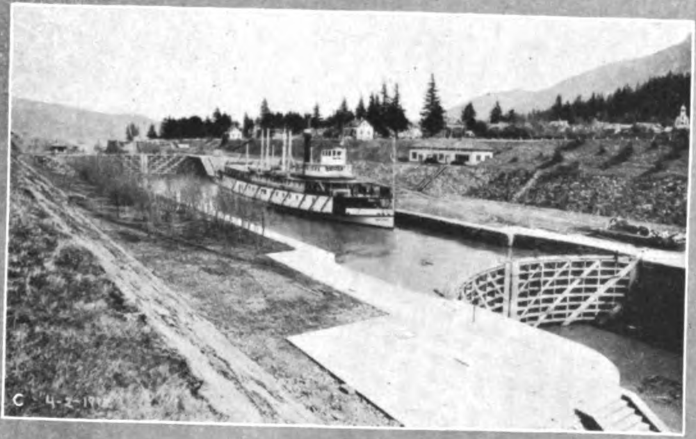
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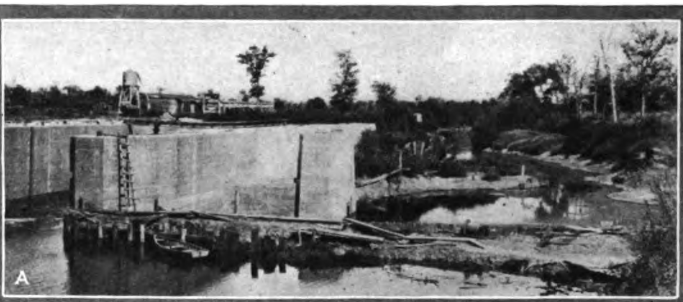
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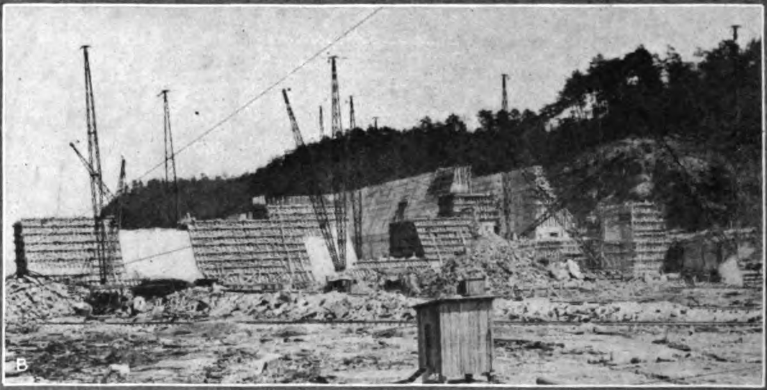
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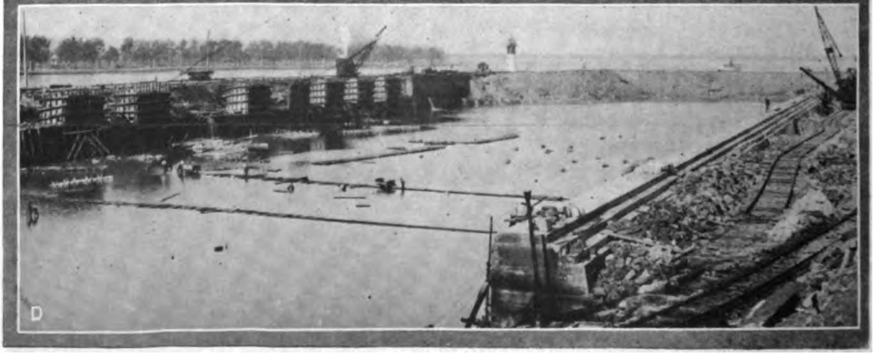
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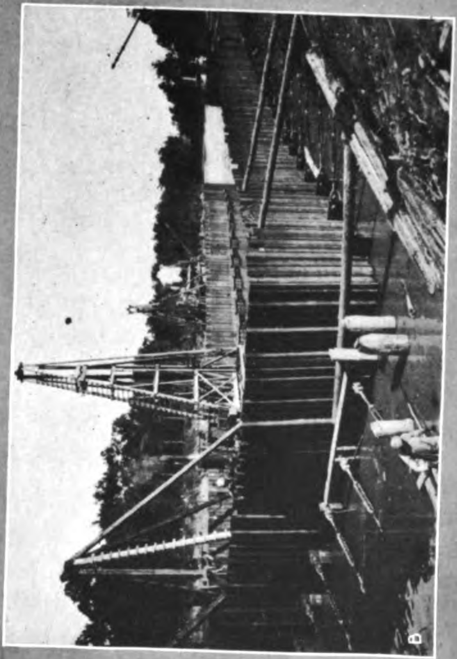
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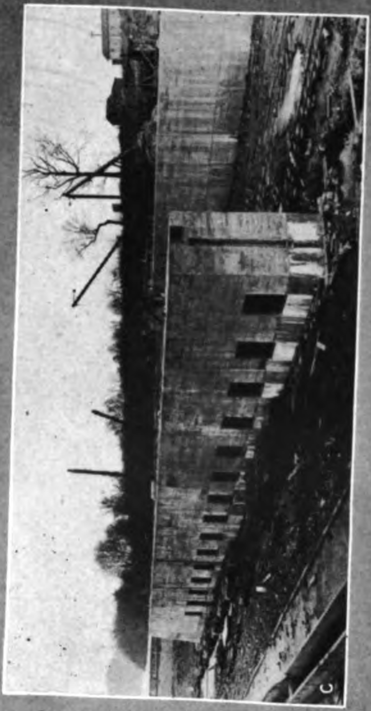
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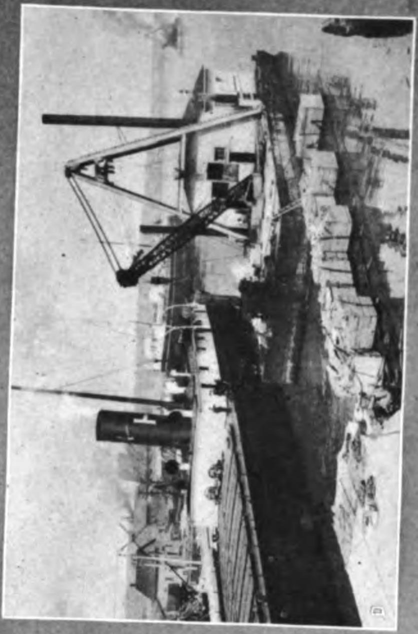
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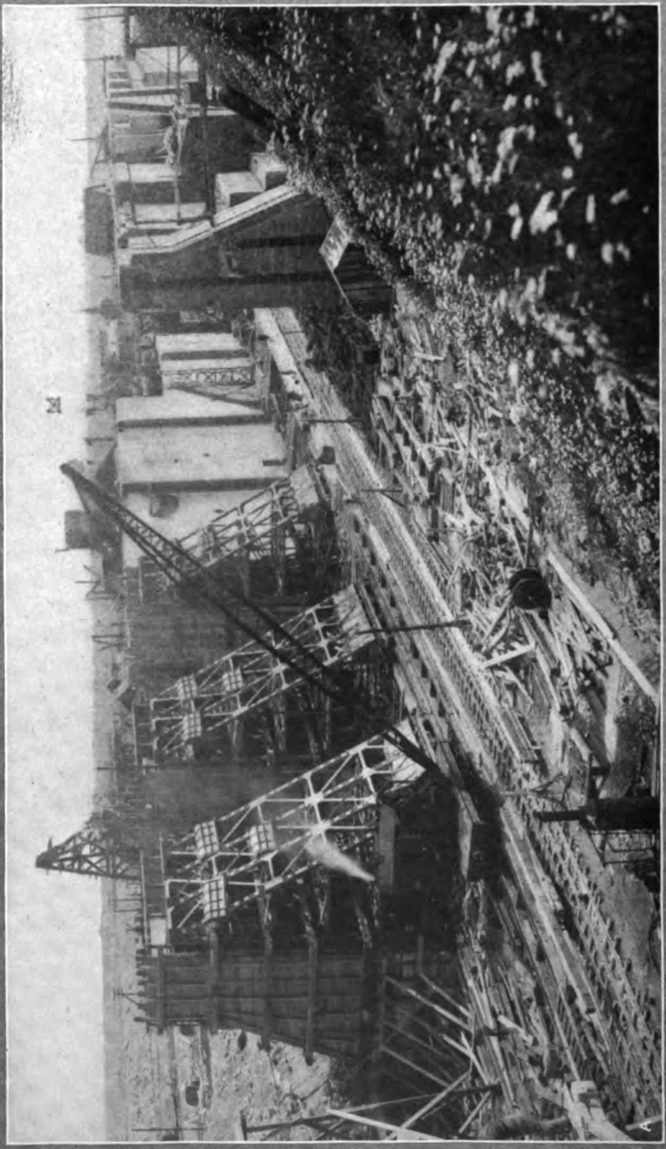
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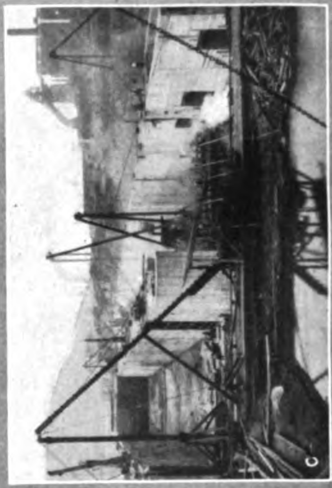
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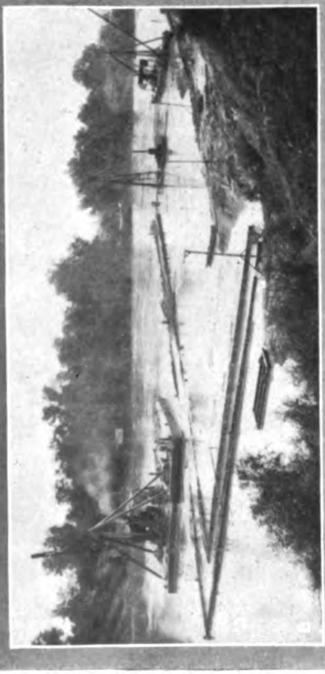

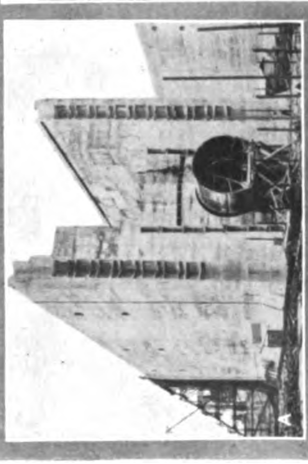
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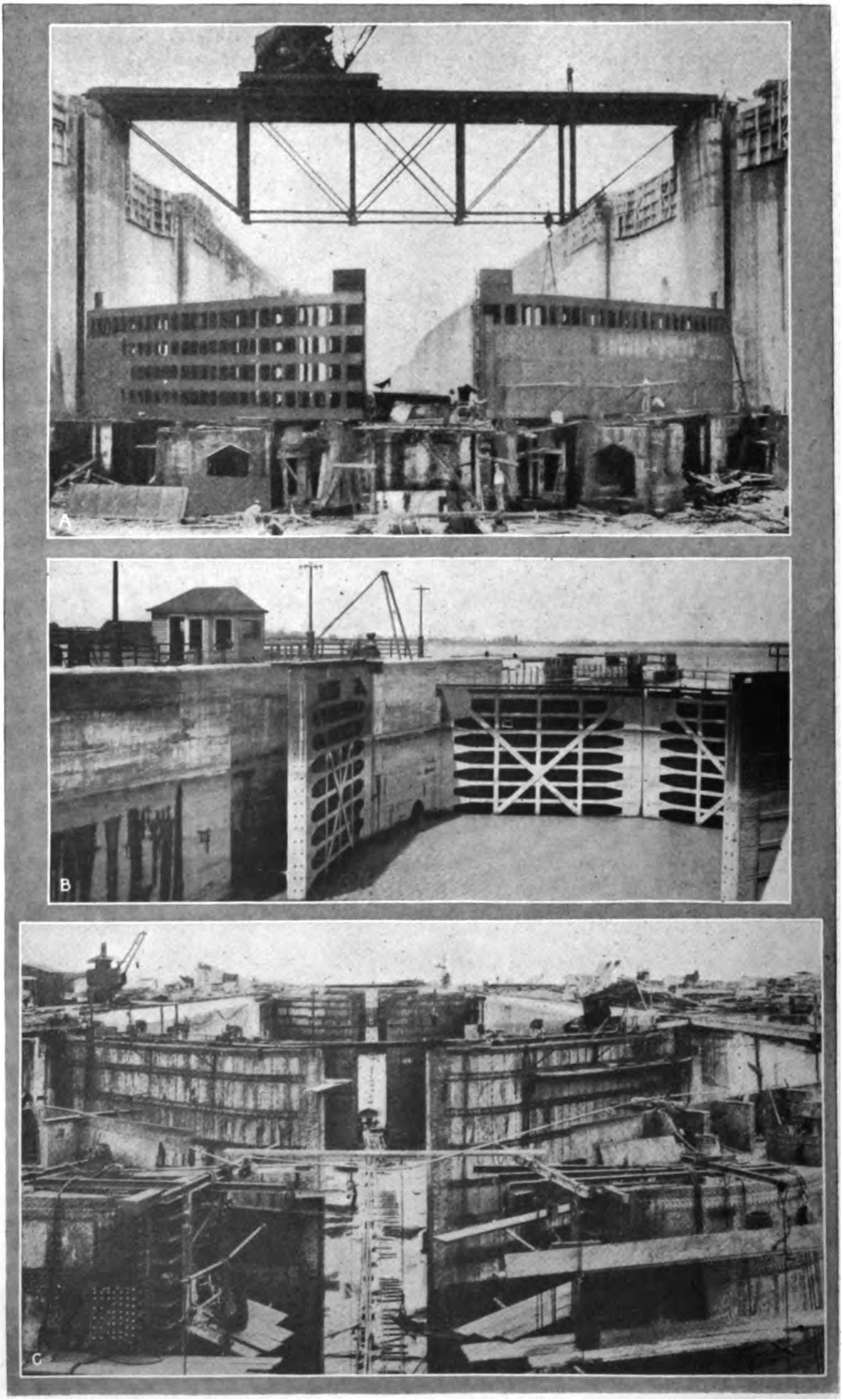
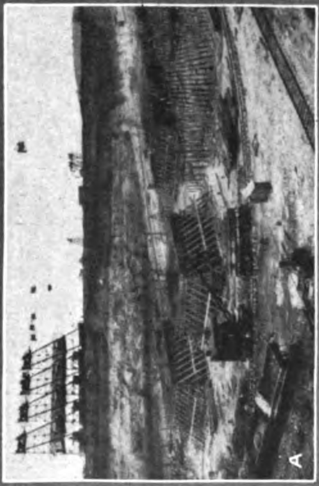
Part VI. Plate 40.





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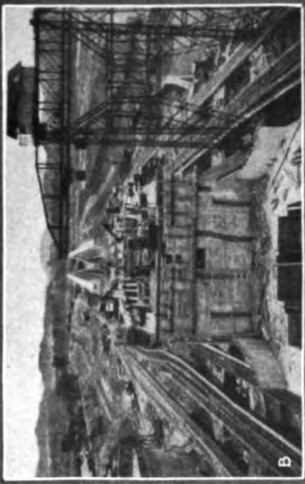

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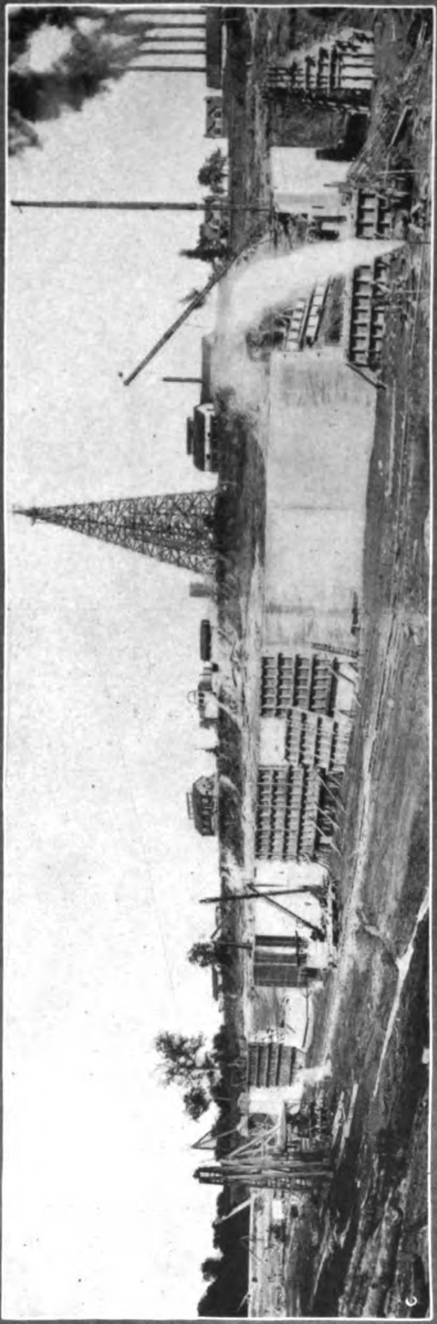

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Part VI. Plate 42.

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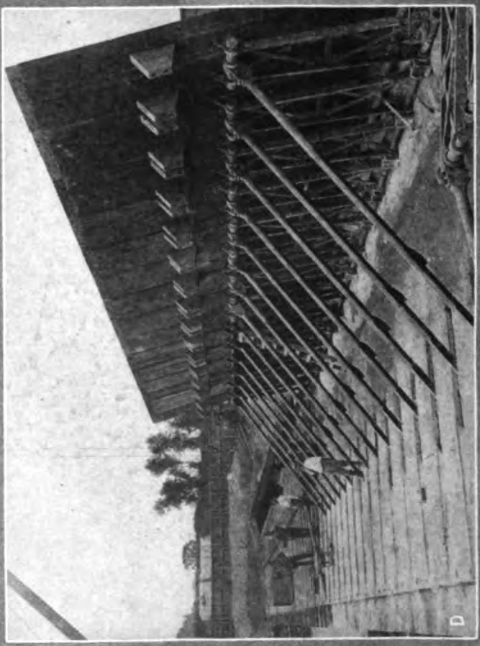
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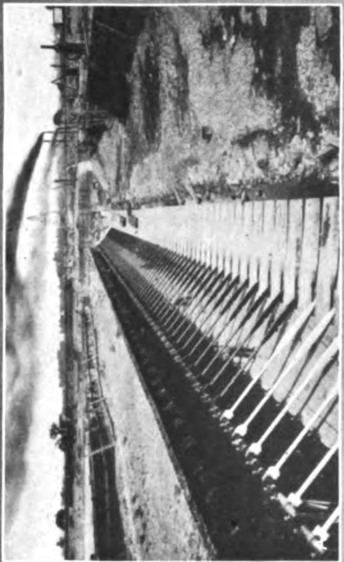

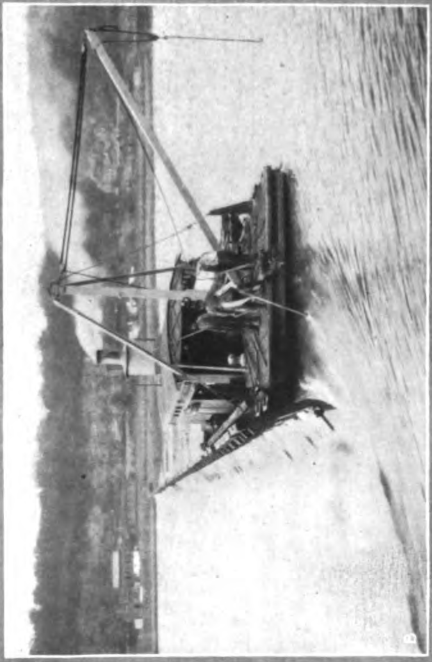

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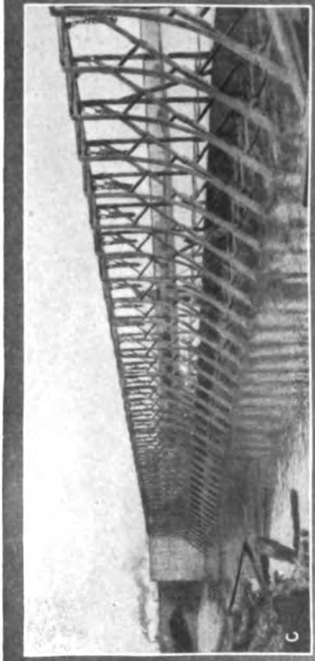

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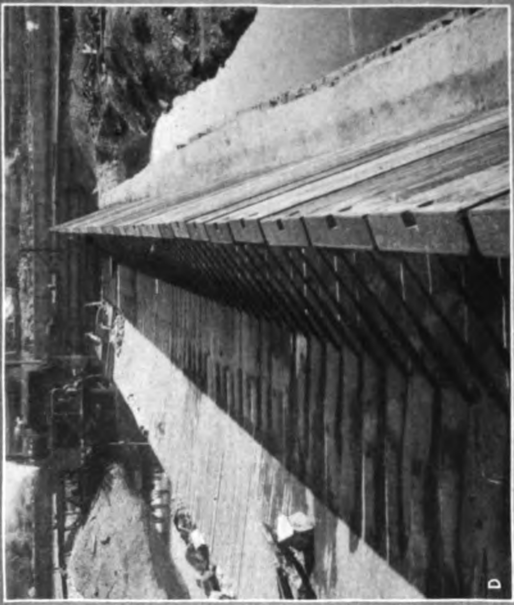

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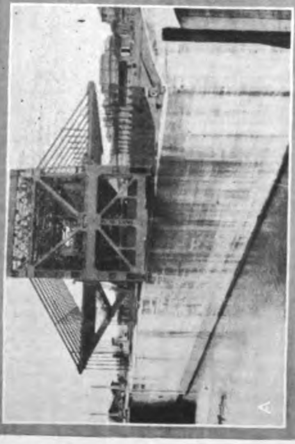

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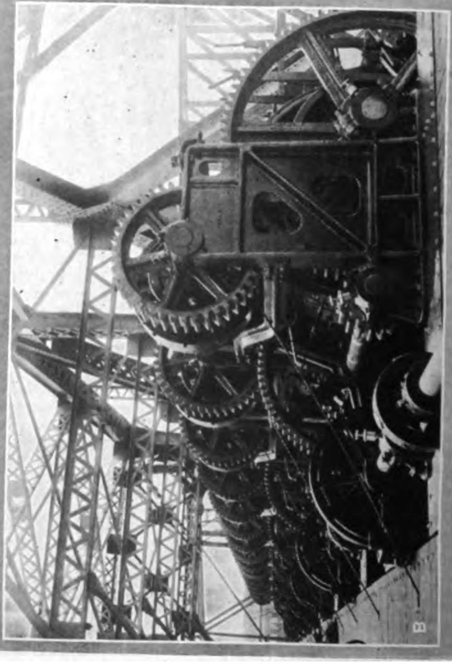

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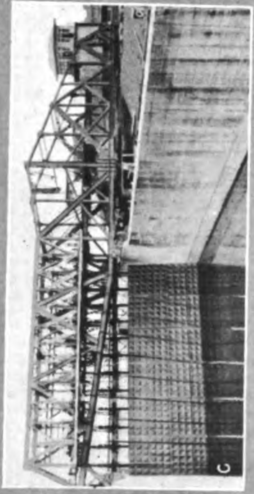

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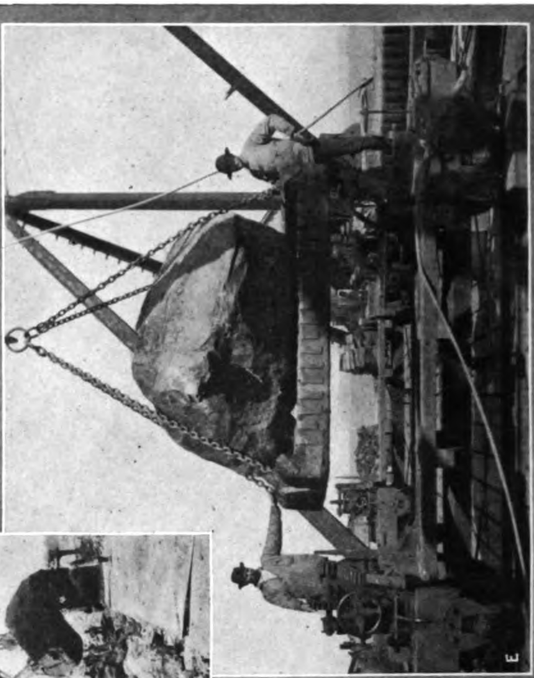
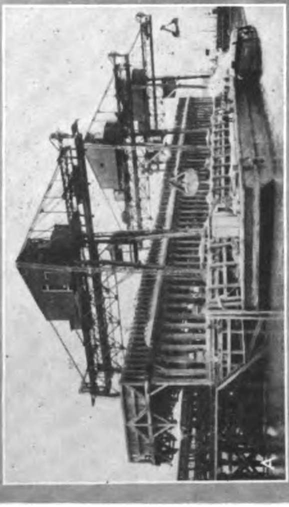
Part VI. Plate 46.





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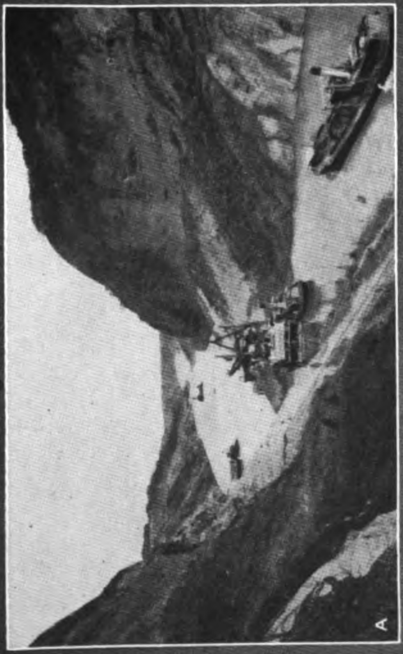
Part VI. Plate 48.



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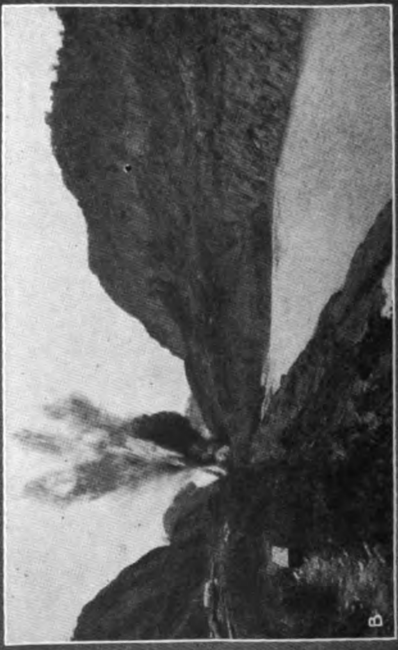

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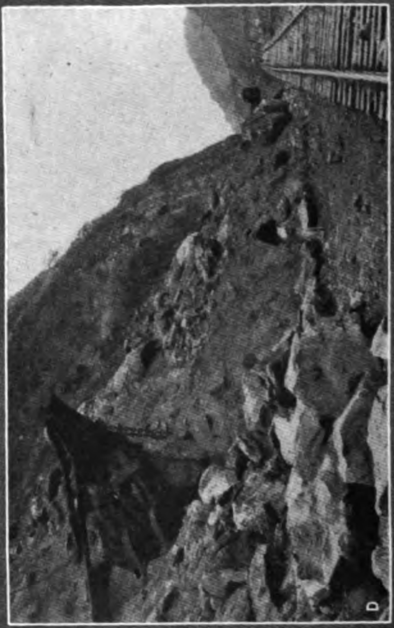

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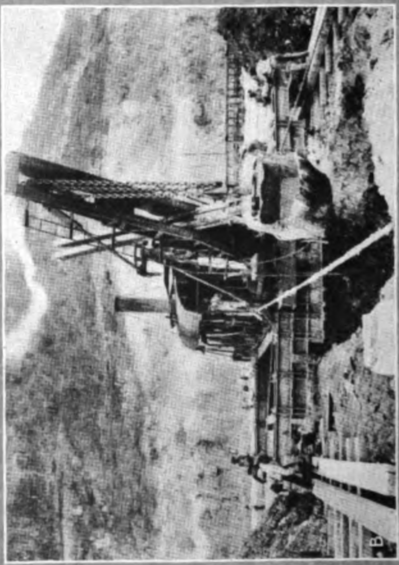

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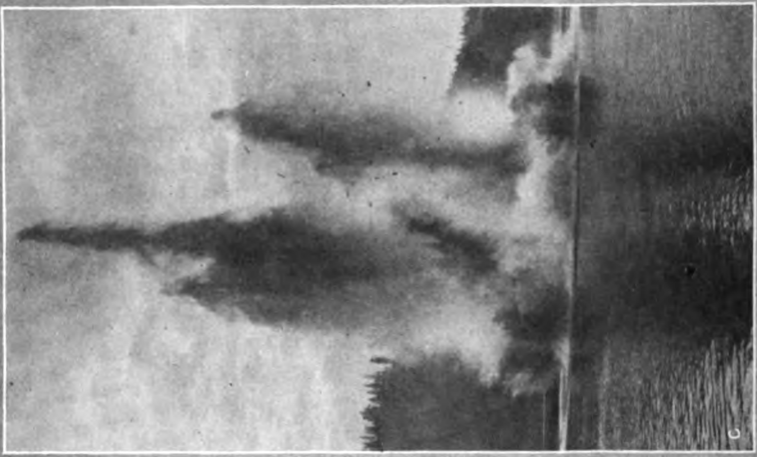

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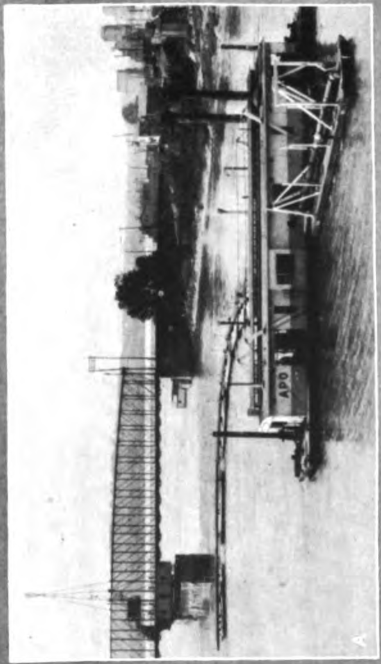
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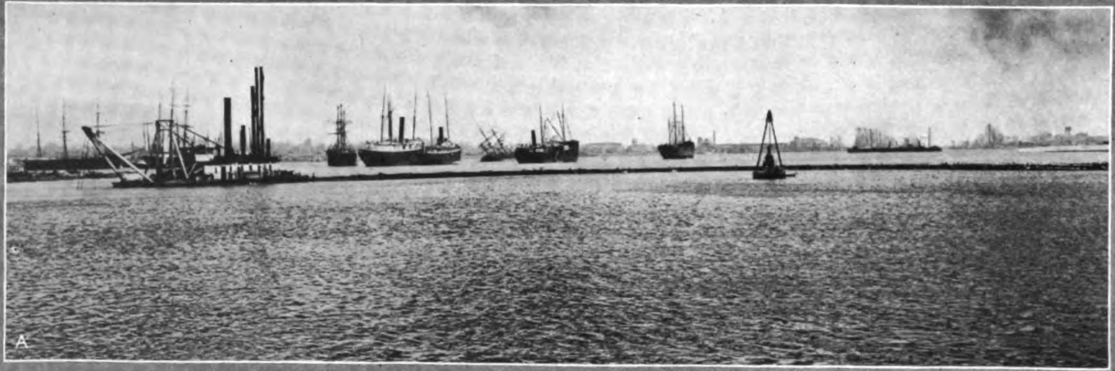
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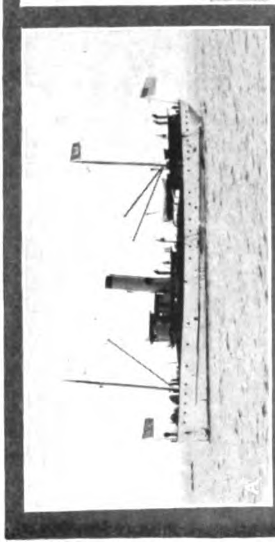
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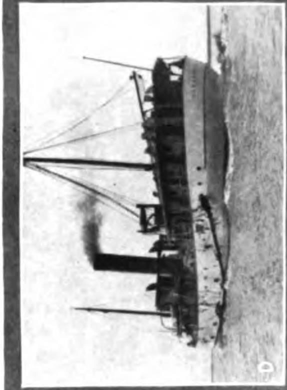
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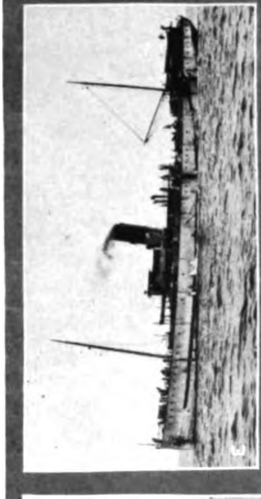
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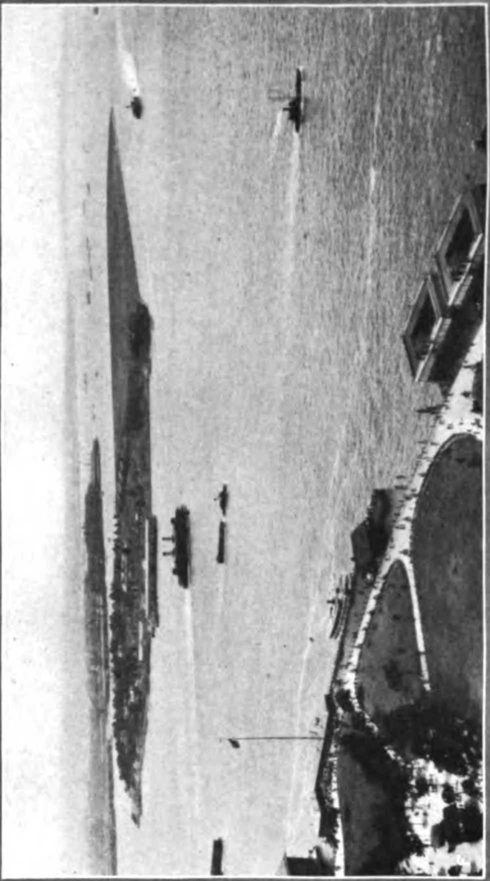
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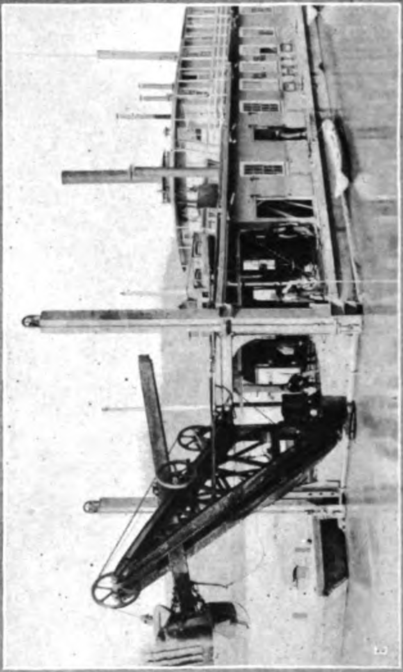
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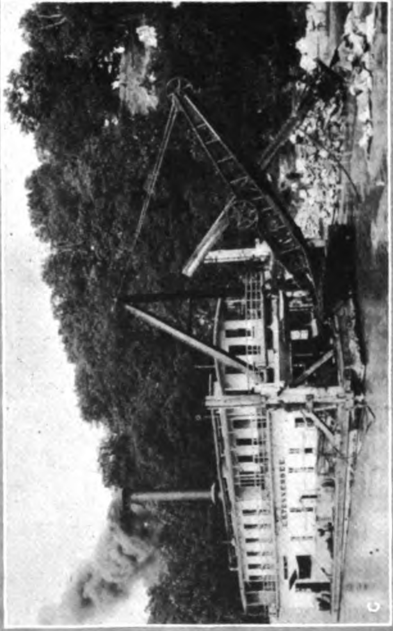
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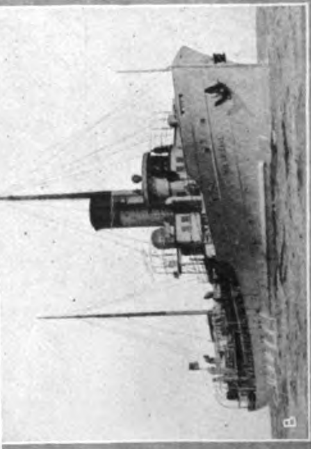
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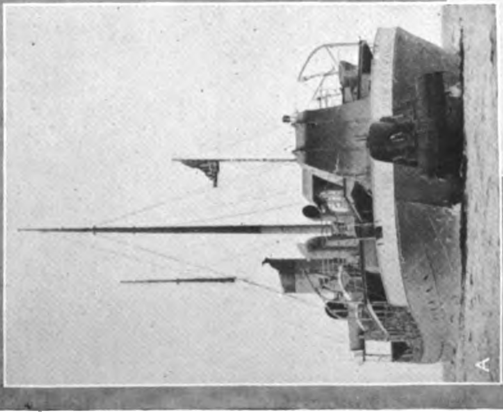
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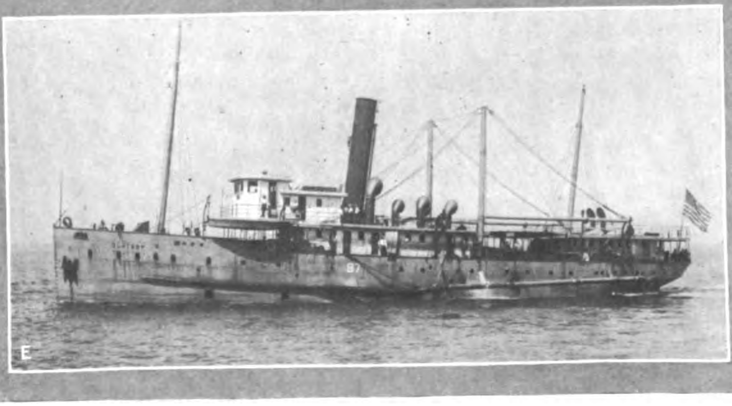
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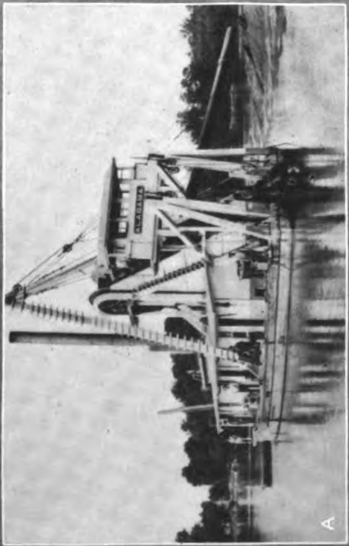
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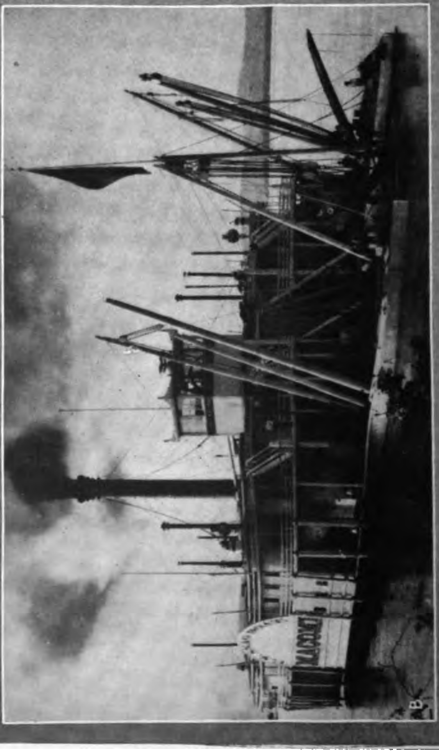
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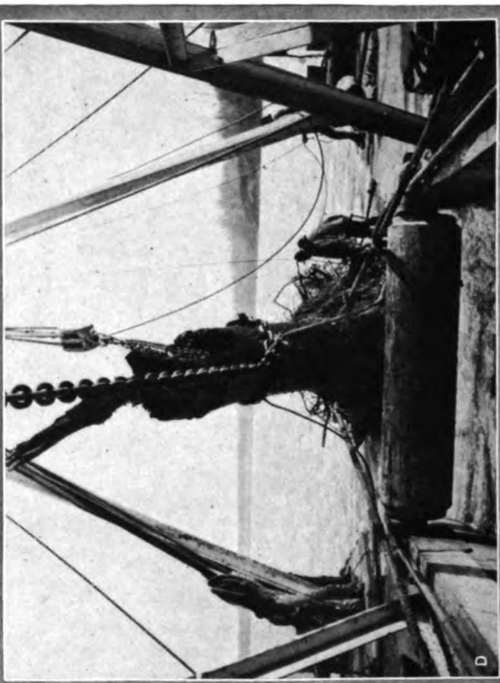
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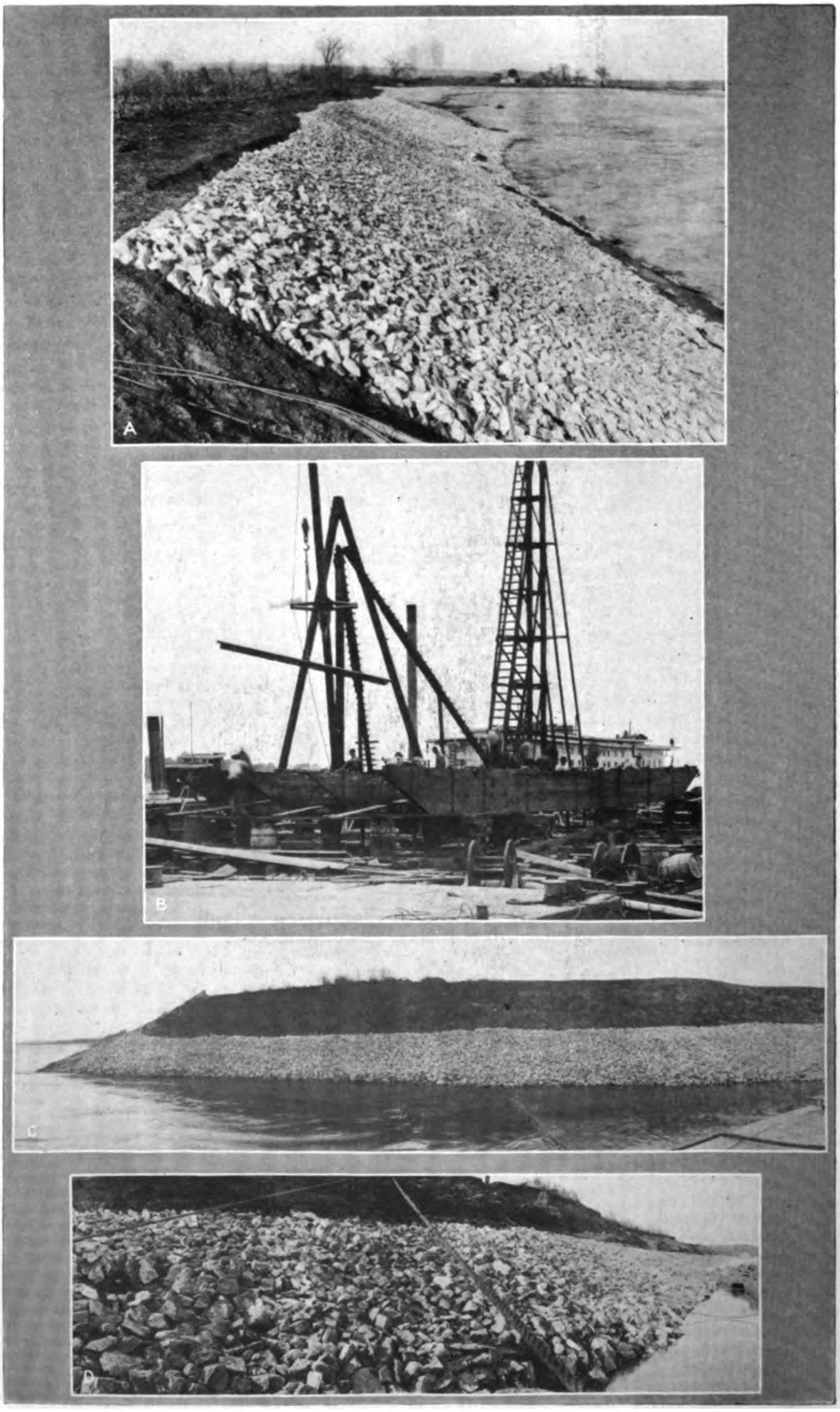
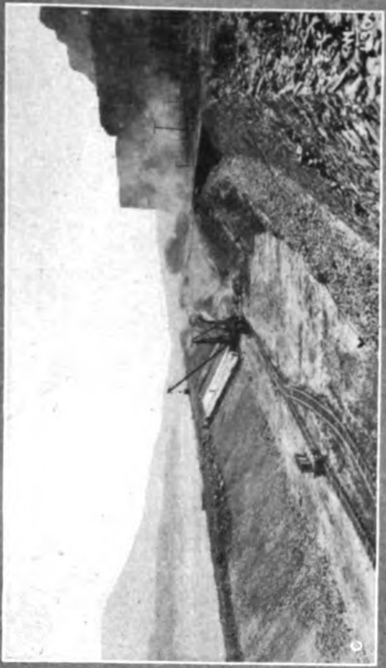
Part VI. Plate 58.

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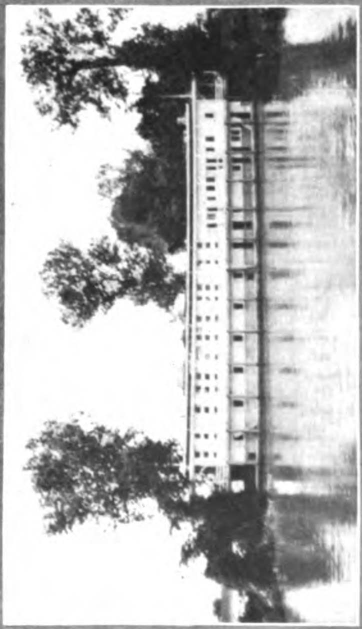

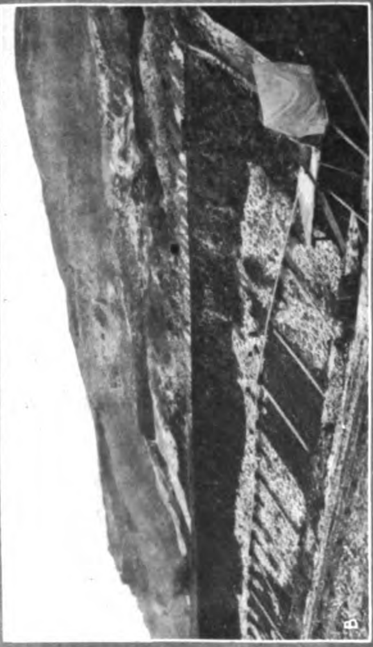
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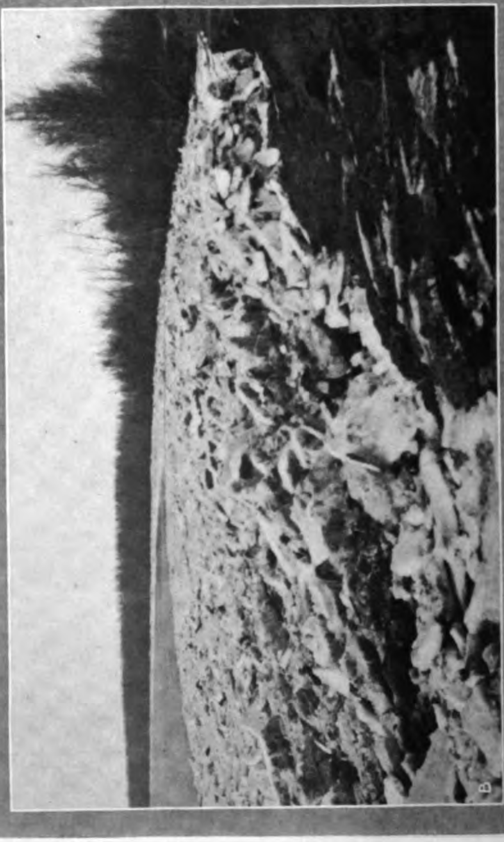
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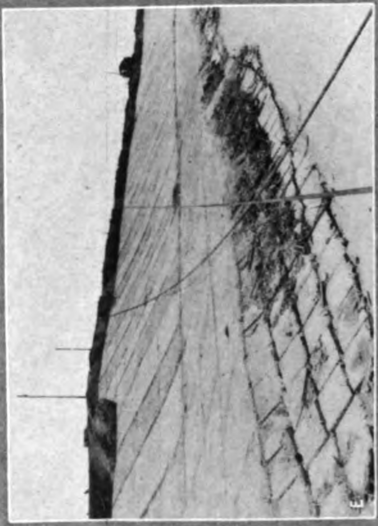
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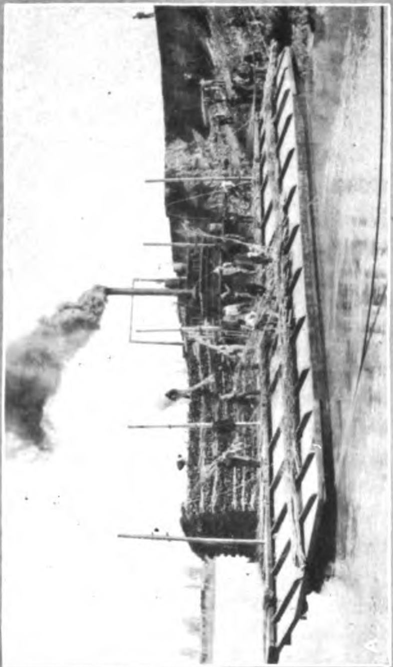

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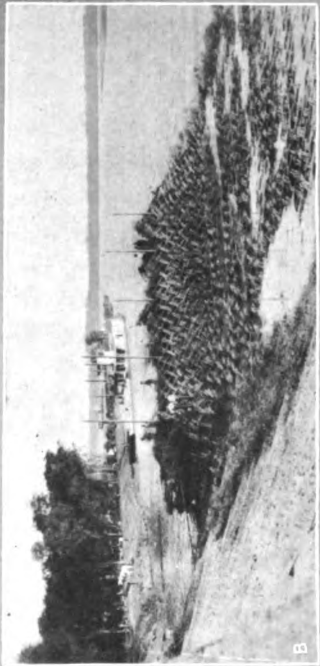

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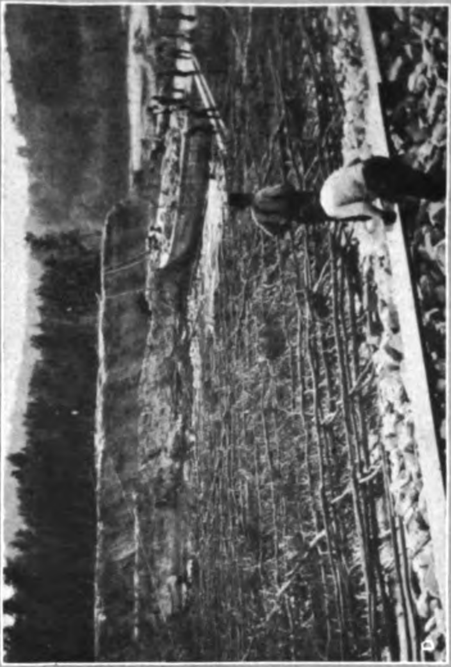

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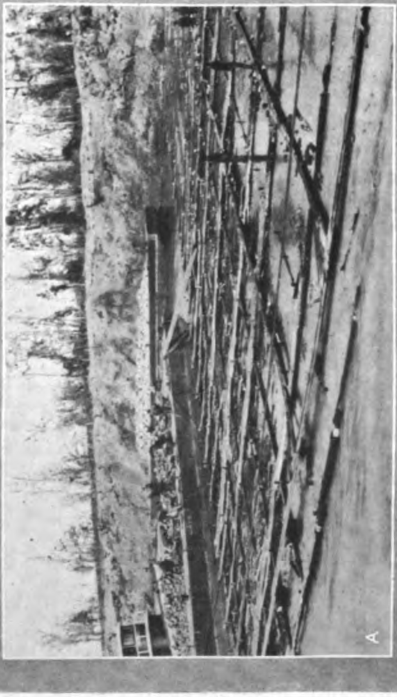
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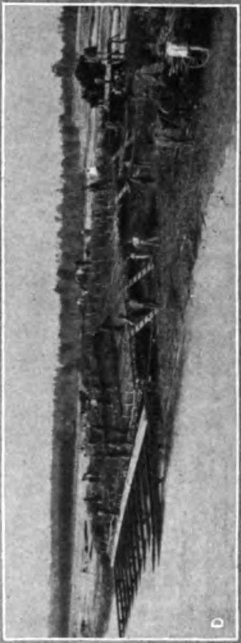
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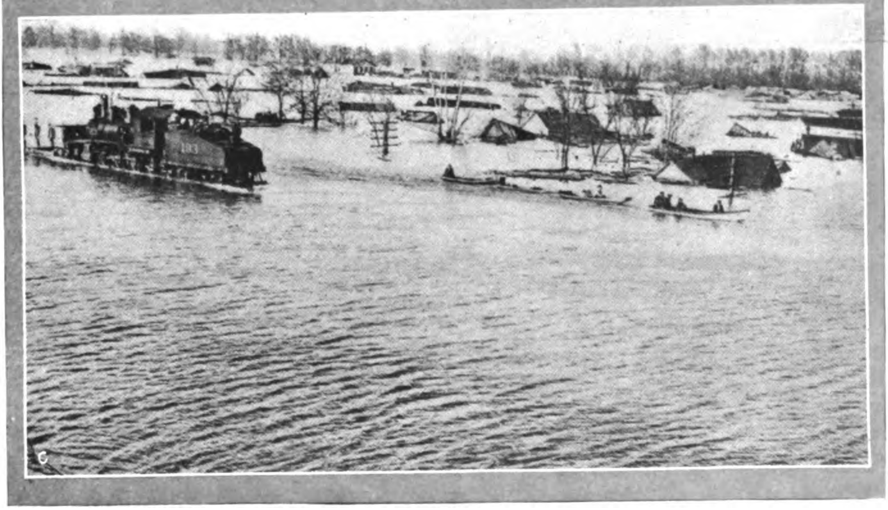
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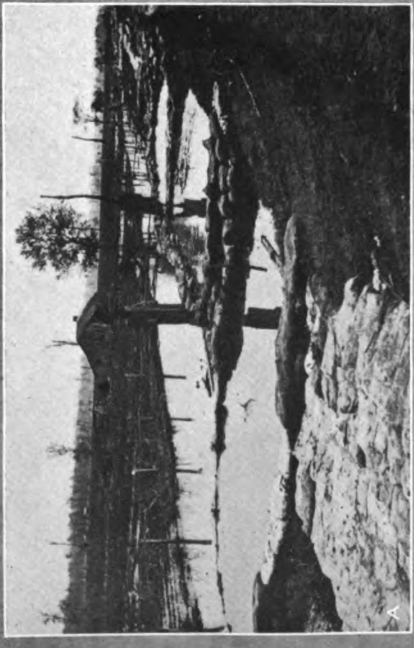
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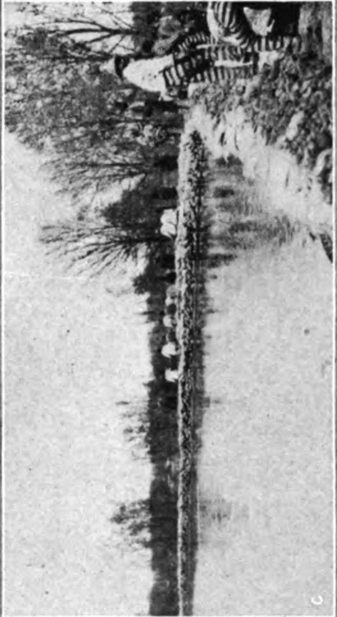
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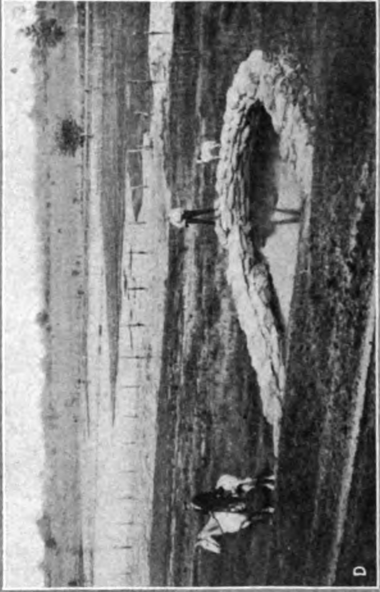
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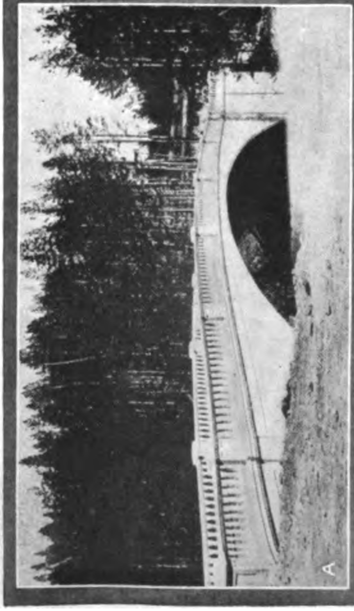
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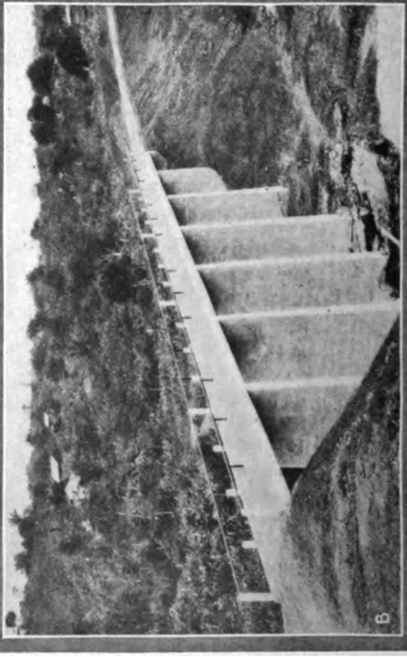
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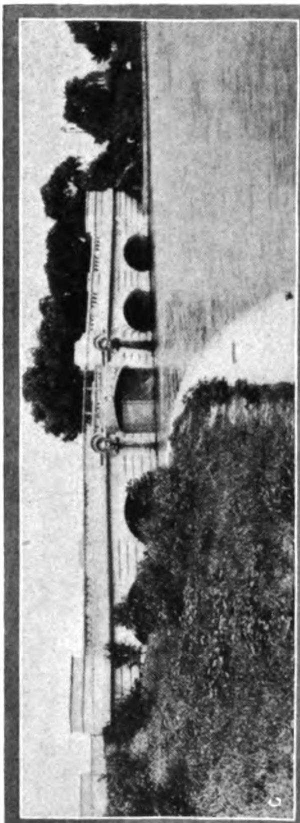
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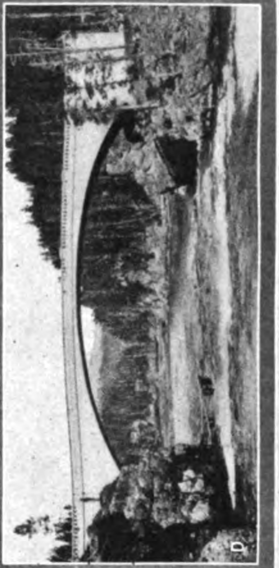
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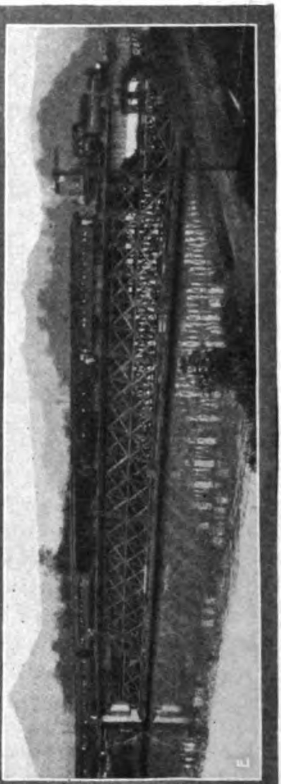
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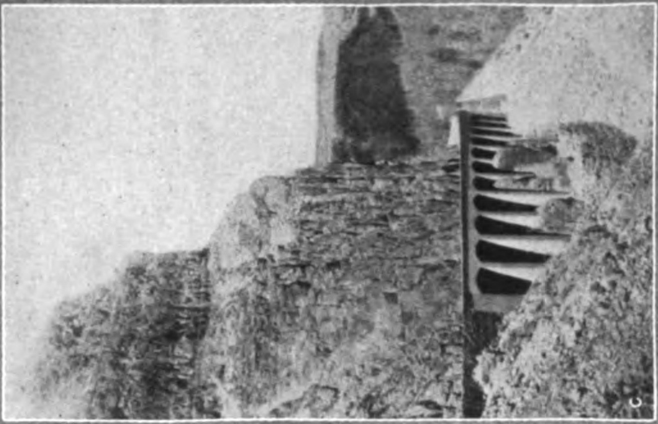

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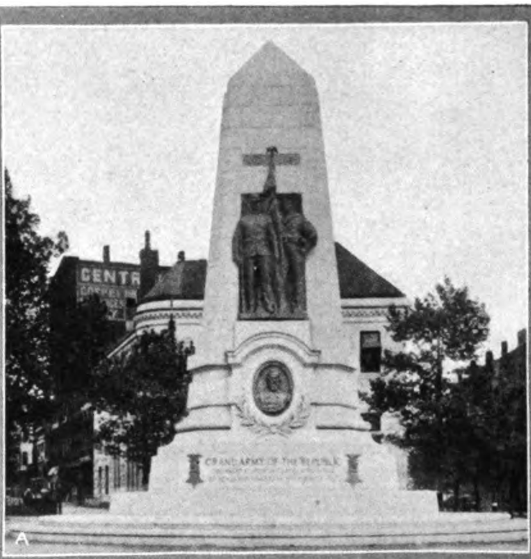
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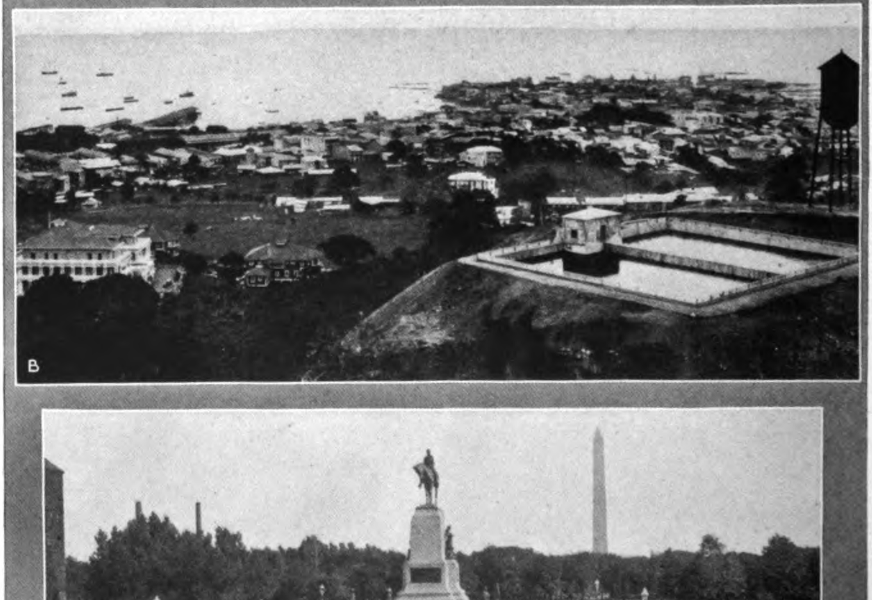
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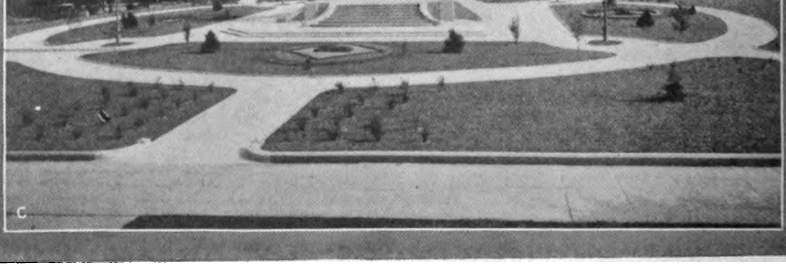
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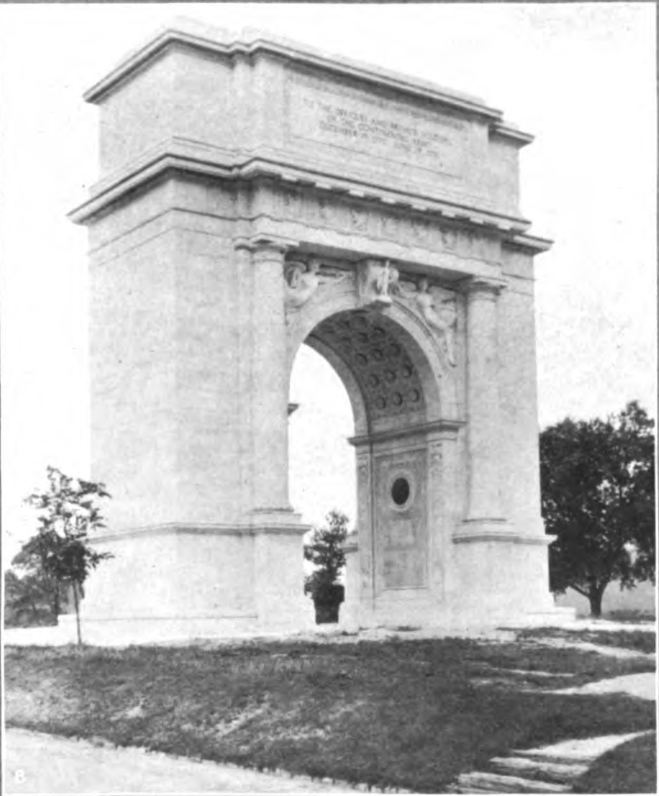
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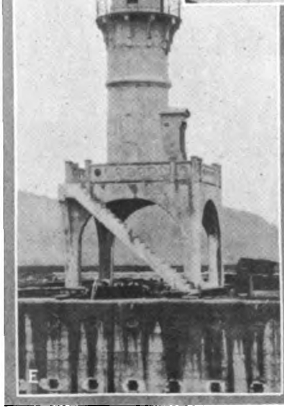
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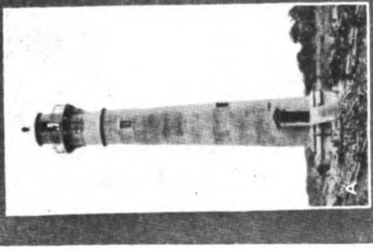
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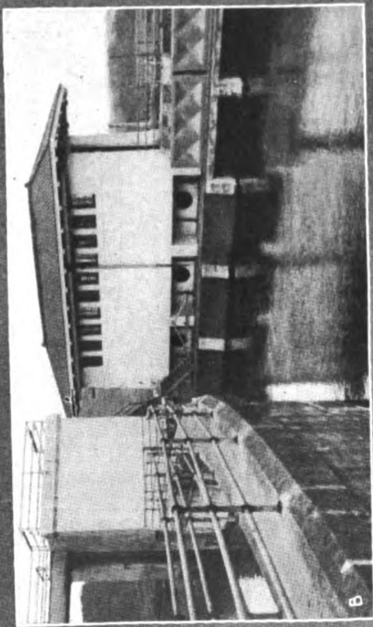
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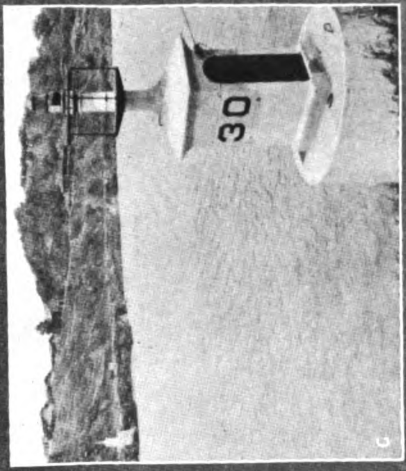
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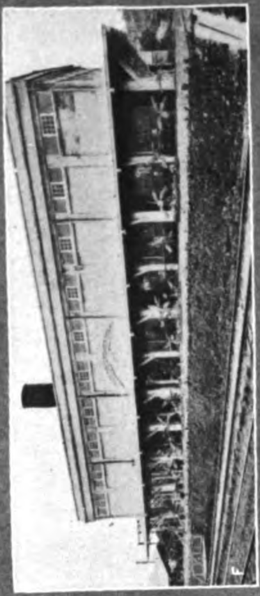
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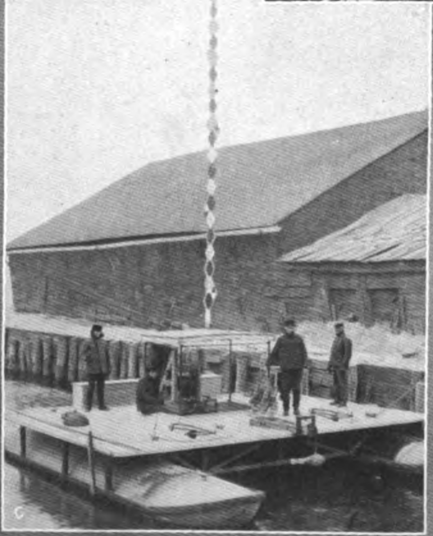

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Sites should not be disclosed prematurely, 01, 2758.

Works, Regulation. (See Regulation.)
Depths, maintaining, Mississippi River, H. D. 50, 61st, 1st.
Channels made by, sediment-bearing rivers, Mississippi River, H. D. 50, 61st, 1st.

Works, River and Harbor. (See Commerce; Harbors; Rivers; Waterways.)
Beneficial effect of, on streams like Red River, 01, 2075.
Commerce, great growth of, incident to, 09, 665.
Manufacturing, extension of, due to, 09, 771.
Rates, freight, effect on, 09, 587.

Wrecking Hook.
Snag boats, 95, 2058.

Wrecks. (See Canals; Steamboats; and p. 2263 of this Index.)
Air bags, inflated, raising, 98, 1234.
Appropriations, insufficient, useless, "Maine," H. D. 919, 61st, 2d.
Canals, 97, 2448.
Canals, removing in, 96, 2232.
Charleston Harbor, 73, 728; 74, ii, 4.
Cofferdams, 11, 3039.
Explosives used, 12, 1654.
Harbor of refuge, Lake Huron, 77, 930.
Lifting, pontoons for, 99, 1277.
"Maine," Habana Harbor, 11, 3039; 12, 3565; H. D. 765, 61st, 3d.
Mississippi River, 96, 1774.
Missouri River, 00, 2691.
Monitor, Patapsco, 73, 728.
Ohio River, 77, 628.
Pacific coast, 81, 2637, 2684.
Raising, inflated air bags for, 98, 1234.
Removing, advertising, objections to, 94, 606.
Removing, black powder used, 73, 728.
Removing, dynamite, 75, ii, 714; 94, 714.
Removing, explosives, 68, 591, 607; 73, 339, 728; 75, ii, 714; 77, 931.
Removing, laws relating to, Rhode Island, 95, 702.
Summary of, Straits of Fuca, etc., 95, 3461; 98, 3086.
Wrecked dredge, authority for removing, question, 98, 2688.
Wrecked steamboats, list of, Missouri River, 97, 3870.
Yasoo River, 73, 483.

Y.

Yangtse River.
Navigation of, S. D. 301, 61st, 2d.

Yankee Catchers (submerged defensive obstructions). (See Obstructions.)

Yankee Catchers—Continued.
In Cape Fear River, 76, 330.
Neuse River, 72, 738; 79, 704, 706.

NOTES.

Pages 1 to 1791, Rivers and Harbors.

INDEX, REPORTS, CHIEF OF ENGINEERS, UNITED STATES ARMY.

1866–1912.

Each engineering district reviewed the proofs of the matter in Vol. I of this Index, pages 23–1692, pertaining to its own reports or works; upon a second opportunity to make such a review the matter incorporated under the heading above was received, but too late for incorporation in the first volume.

SESSIONS OF CONGRESS.

Congress.	Session.	From—	To—	Congress.	Session.	From—	To—
1st	1st	Mar. 4, 1789	Sept. 29, 1789	34th	1st	Dec. 3, 1855	Aug. 18, 1856
	2d	Jan. 4, 1790	Aug. 12, 1790		2d	Aug. 21, 1856	Aug. 30, 1856
	3d	Dec. 6, 1790	Mar. 3, 1791		3d	Dec. 1, 1856	Mar. 3, 1857
2d	1st	Oct. 24, 1791	May 8, 1792	35th	1st	Dec. 7, 1857	June 14, 1858
	2d	Nov. 5, 1792	Mar. 2, 1793		2d	Dec. 6, 1858	Mar. 3, 1859
3d	1st	Dec. 2, 1793	June 9, 1794	36th	1st	Dec. 5, 1859	June 25, 1860
	2d	Nov. 3, 1794	Mar. 3, 1795		2d	Dec. 3, 1860	Mar. 3, 1861
4th	1st	Dec. 7, 1795	June 1, 1796	37th	1st	July 4, 1861	Aug. 6, 1861
	2d	Dec. 5, 1796	Mar. 3, 1797		2d	Dec. 2, 1861	July 17, 1862
5th	1st	May 15, 1797	July 10, 1797		3d	Dec. 1, 1862	Mar. 3, 1863
	2d	Nov. 13, 1797	July 16, 1798	38th	1st	Dec. 7, 1863	July 4, 1864
	3d	Dec. 3, 1798	Mar. 3, 1799		2d	Dec. 5, 1864	Mar. 3, 1865
6th	1st	Dec. 2, 1799	May 14, 1800	39th	1st	Dec. 4, 1865	July 28, 1866
	2d	Nov. 17, 1800	Mar. 3, 1801		2d	Dec. 3, 1866	Mar. 2, 1867
7th	1st	Dec. 7, 1801	May 3, 1802	40th	1st	Mar. 4, 1867	Dec. 2, 1867
	2d	Dec. 6, 1802	Mar. 3, 1803		2d	Dec. 2, 1867	Nov. 10, 1868
8th	1st	Oct. 17, 1803	Mar. 27, 1804		3d	Dec. 7, 1868	Mar. 3, 1869
	2d	Nov. 5, 1804	Mar. 3, 1805	41st	1st	Mar. 4, 1869	Apr. 22, 1869
9th	1st	Dec. 2, 1805	Apr. 21, 1806		2d	Dec. 6, 1869	July 15, 1870
	2d	Dec. 1, 1806	Mar. 3, 1807		3d	Dec. 5, 1870	Mar. 3, 1871
10th	1st	Oct. 16, 1807	Apr. 25, 1808	42d	1st	Mar. 4, 1871	May 27, 1871
	2d	Nov. 7, 1808	Mar. 3, 1809		2d	Dec. 4, 1871	June 10, 1872
11th	1st	May 22, 1809	June 28, 1809		3d	Dec. 2, 1872	Mar. 3, 1873
	2d	Nov. 27, 1809	May 1, 1810	43d	1st	Dec. 1, 1873	June 23, 1874
	3d	Dec. 3, 1810	Mar. 3, 1811		2d	Dec. 7, 1874	Mar. 3, 1875
12th	1st	Nov. 4, 1811	July 6, 1812	44th	1st	Dec. 6, 1875	Aug. 15, 1876
	2d	Nov. 2, 1812	Mar. 3, 1813		2d	Dec. 4, 1876	Mar. 3, 1877
13th	1st	May 24, 1813	Aug. 2, 1813	45th	1st	Oct. 15, 1877	Dec. 3, 1877
	2d	Dec. 6, 1813	Apr. 18, 1814		2d	Dec. 3, 1877	June 20, 1878
	3d	Sept. 19, 1814	Mar. 3, 1815		3d	Dec. 2, 1878	Mar. 3, 1879
14th	1st	Dec. 4, 1815	Apr. 29, 1816	46th	1st	Mar. 18, 1879	July 1, 1879
	2d	Dec. 2, 1816	Mar. 3, 1817		2d	Dec. 1, 1879	June 16, 1880
15th	1st	Dec. 1, 1817	Apr. 20, 1818		3d	Dec. 6, 1880	Mar. 3, 1881
	2d	Nov. 16, 1818	Mar. 3, 1819	47th	1st	Dec. 5, 1881	Aug. 8, 1882
16th	1st	Dec. 6, 1819	May 15, 1820		2d	Dec. 4, 1882	Mar. 3, 1883
	2d	Nov. 13, 1820	Mar. 3, 1821	48th	1st	Dec. 3, 1883	July 7, 1884
17th	1st	Dec. 3, 1821	May 8, 1822		2d	Dec. 1, 1884	Mar. 3, 1885
	2d	Dec. 2, 1822	Mar. 3, 1823	49th	1st	Dec. 7, 1885	Aug. 5, 1886
18th	1st	Dec. 1, 1823	May 27, 1824		2d	Dec. 6, 1886	Mar. 3, 1887
	2d	Dec. 6, 1824	Mar. 3, 1825	50th	1st	Dec. 5, 1887	Oct. 20, 1888
19th	1st	Dec. 5, 1825	May 22, 1826		2d	Dec. 3, 1888	Mar. 2, 1889
	2d	Dec. 4, 1826	Mar. 3, 1827	51st	1st	Dec. 2, 1889	Oct. 1, 1890
20th	1st	Dec. 3, 1827	May 26, 1828		2d	Dec. 1, 1890	Mar. 3, 1891
	2d	Dec. 1, 1828	Mar. 3, 1829	52d	1st	Dec. 7, 1891	Aug. 5, 1892
21st	1st	Dec. 7, 1829	May 31, 1830		2d	Dec. 5, 1892	Mar. 3, 1893
	2d	Dec. 6, 1830	Mar. 3, 1831	53d	1st	Aug. 7, 1893	Nov. 3, 1893
22d	1st	Dec. 5, 1831	July 16, 1832		2d	Dec. 4, 1893	Aug. 28, 1894
	2d	Dec. 3, 1832	Mar. 2, 1833		3d	Dec. 3, 1894	Mar. 2, 1895
23d	1st	Dec. 2, 1833	June 3, 1834	54th	1st	Dec. 2, 1895	June 11, 1896
	2d	Dec. 1, 1834	Mar. 3, 1835		2d	Dec. 7, 1896	Mar. 3, 1897
24th	1st	Dec. 7, 1835	July 4, 1836	55th	1st	Mar. 15, 1897	July 24, 1897
	2d	Dec. 5, 1836	Mar. 3, 1837		2d	Dec. 6, 1897	July 8, 1898
25th	1st	Sept 4, 1837	Oct. 16, 1837		3d	Dec. 5, 1898	Mar. 3, 1899
	2d	Dec. 4, 1837	July 9, 1838	56th	1st	Dec. 4, 1899	June 7, 1900
	3d	Dec. 3, 1838	Mar. 3, 1839		2d	Dec. 3, 1900	Mar. 2, 1901
26th	1st	Dec. 2, 1839	July 31, 1840	57th	1st	Dec. 2, 1901	July 1, 1902
	2d	Dec. 7, 1840	Mar. 3, 1841		2d	Dec. 1, 1902	Mar. 3, 1903
27th	1st	May 31, 1841	Sept. 13, 1841	58th	1st	Nov. 9, 1903	Dec. 7, 1903
	2d	Dec. 6, 1841	Aug. 31, 1842		2d	Dec. 7, 1903	Apr. 28, 1904
	3d	Dec. 5, 1842	Mar. 3, 1843		3d	Dec. 5, 1904	Mar. 3, 1905
28th	1st	Dec. 4, 1843	June 17, 1844	59th	1st	Dec. 4, 1905	June 30, 1906
	2d	Dec. 2, 1844	Mar. 3, 1845		2d	Dec. 3, 1906	Mar. 2, 1907
29th	1st	Dec. 1, 1845	Aug. 10, 1846	60th	1st	Dec. 2, 1907	May 30, 1908
	2d	Dec. 7, 1846	Mar. 3, 1847		2d	Dec. 7, 1908	Mar. 3, 1909
30th	1st	Dec. 6, 1847	Aug. 14, 1848	61st	1st	Mar. 15, 1909	Aug. 5, 1909
	2d	Dec. 4, 1848	Mar. 3, 1849		2d	Dec. 6, 1909	June 25, 1910
31st	1st	Dec. 3, 1849	Sept. 30, 1850		3d	Dec. 5, 1910	Mar. 3, 1911
	2d	Dec. 2, 1850	Mar. 3, 1851	62d	1st	Apr. 4, 1911	Aug. 22, 1911
32d	1st	Dec. 1, 1851	Aug. 31, 1852		2d	Dec. 4, 1911	Aug. 26, 1912
	2d	Dec. 6, 1852	Mar. 3, 1853		3d	Dec. 2, 1912	Mar. 3, 1913
33d	1st	Dec. 5, 1853	Aug. 7, 1854	63d	1st	Apr. 7, 1913	Dec. 1, 1913
	2d	Dec. 4, 1854	Mar. 3, 1855				

FRONTISPIECE MAP.

DISTRICTS AND DIVISIONS, AND OFFICES, ETC.

The boundaries of these may change according to the exigencies of the work under the care of the Corps of Engineers. See below.

REFERENCES.

(Page 15.)

Sometimes the text, pages 1 to 1791, refers to H. D. 482, 55th Cong., 2d, and sometimes to H. D. 421, 57th Cong., 2d. These are practically the same, the one of later date embracing the facts up to that later date. (H. D. 1491, 63d, 3d is the latest edition, and so more embracive than the others named above.)

(Page 19.)

ORDER OF ARRANGEMENT OF WATERWAY GROUPS, AND UNITED STATES ENGINEER OFFICES.

The waterways of the United States, as listed in Volume I, are arranged in sequential geographical groups. Usually these groups correspond with the areas in the care of the local United States Engineer office in charge of works of defense and of improvements on waterways. Sometimes, for various reasons, the limits or area under the care of a United States Engineer office may be changed, so that waterway improvements in one or more of the groups named in Volume 1 may be under the care of an office other than named in Volume 1. This fact may be particularly noticeable in the case of waterways which begin or end any list of waterways in Volume I.

Any request for information concerning a waterway, addressed to the United States Engineer Office deemed to be in charge of the waterway concerned, would, usually, be forwarded direct to the United States Engineer Office actually in charge.

A.—PORTLAND, ME., DISTRICT.

(Page 24.)

MAPS, PLATE 1.
ENGLISHMAN R.—This should be changed to "Chandler R."

(Page 27.)

EAST MACHIAS RIVER, ME. (A-15)
It is tributary to Machias R., Me., No. 14.

(Page 28.)

PASSAGASAWAKEAG RIVER, ME. (A-139)
A tributary of Belfast H., Me. (A-138)

ROBIN HOOD COVE, ME. (A-213)
Tributary to Knubble Bay, Me. (A-212)

SAGADAHOC BAY, ME. (A-218)
Tributary to Stage Island Bay, Me. (A-217)

(Page 29.)

DRUMMORE, ME. (A-237)
This is Drummore Bay.

(Page 32.)

MOOSABEC BAR, ME. (A-22(a))
CONTRACTS.—1885. Moore & Wright, dr., 38¢ c. y., s. m., 86, 534.

(Page 36.)

BASS HARBOR BAR, ME.
Change number to A-57(a).

BASS HARBOR BAR AND DEER ISLAND THOROUGHFARE, ME.
Change number to A-57(b).

(Page 39.)

PENOBSCOT RIVER, ME. (A-101)
PROJECTS.—Omit the reference to footnote 1 after estimate of $130,000, in the last paragraph, referring to act Mar. 2, 1907.

(Page 43.)

CAMDEN HARBOR, ME. (A-142)
PROJECTS.—First paragraph: The reference in the third line is to mean low water.

(Page 44.)

ROCKPORT HARBOR, ME. (A-143)
PROJECTS.—Change reference to footnote 1, in the second paragraph, instead of to 2.

(Page 50.)

KENNEBEC RIVER, ME. (A-219)
SURVEYS.—Add, in the last paragraph, reference to footnote 3, under Maps.

(Page 63.)

LAMPREY RIVER, ME. (A-288)
SURVEYS.—The footnote reference is to H. D. 1066, 61st, 3d.

(Page 64.)

EXETER RIVER, N. H. (A-289)
PROJECTS.—See below.
SURVEYS.—The proper reference under "Map" is to footnote 1, or H. D. 1090, 61st, 3d.

(Page 65.)

ISLES OF SHOALS HARBOR, ME. AND N. H. (A-291)
SURVEYS.—Add the following reference under "Map," namely, to footnote 3.

B.—BOSTON, MASS., DISTRICT.

ENGINEERS.

Col. F. V. Abbot was in charge of district from 1910.

See Newburyport H., page 71, for list of Corps of Engineers assistants.

(Page 69.)

POWWOW RIVER, MASS. (B-5) (See below)
In Mass. only.

(Page 71.)

NEWBURYPORT HARBOR, MASS. (B-3)
OPERATIONS.—1904-5. 75′ of core is correct instead of 71′.

(Page 72.)

1911-12. Project named 85% completed on **12**, 69.

SURVEYS.—List of Congressional Docs., etc., to be found on **12**, 68.

(Page 74.)

POWWOW RIVER, MASS. (See above.) **(B-5)**
PHYSICAL CHARACTERISTICS.—Omit reference **02**, 85.

(Page 75.)

IPSWICH RIVER, MASS. (B-60)
ESTIMATES.—Date should be 1873, not 1872. Add the following paragraph—"By Lt. Col. Thom, 1875, improving R.; by chan. 4′ x 60′, $25,000; for chan. 9′ x 60′, $300,000; **76**, 199, 201, 202."

(Page 76.)

SURVEYS.—First paragraph—Date should be 1873, not 1872.

ESSEX RIVER, MASS. (B-66)
OPERATIONS.—1909-1910. 30 point 187 c. y. bowlders is correct, not 30,187.

(Page 78.)

SANDY BAY, MASS. (B-77)
PROJECTS.—Reference in last paragraph should be to **10**, 65.

ROCKPORT HARBOR, MASS. (B-79)
APPROPRIATIONS.—Item of 1902 is $22,000, **02**, 856.
SURVEYS.—Reference is to **00**, 1177, 1178.

GLOUCESTER HARBOR, MASS. (B-83)
APPROPRIATIONS.—Item of 1823 is for $6,000.

(Page 79.)

CONTRACTS.—1899. Reference is to **00**, 1165.

PROJECTS.—Omit estimate of $752,000 in item relating to Col. Mansfield, 1894.

(Page 80.)

BEVERLY HARBOR, MASS. (B-92)
ENGINEERS IN CHARGE.—Lt. Col. G. L. Gillespie, 1888. **R., 90**, 524. Lt. Col. S. M. Mansfield, 1889-90.

(Page 81.)

CRANE AND WATERS RIVERS, MASS. (B-96, 97)
ENGINEERS IN CHARGE.—Lt. Col. G. L. Gillespie, 1888-89, and Lt. Col. S. M. Mansfield.

SALEM HARBOR, MASS. (B-100)
ENGINEERS IN CHARGE.—Lt. Col. G. L. Gillespie, 1888. **R., 90**, 528.

(Page 82.)

PROJECTS.—Reference to Stanton project item is **04**, 883-4. No est., by Col., for maintenance.

LYNN HARBOR, MASS. (B-108)
APPROPRIATIONS.—1912 item was for western or Saugus R. chan.

(Page 83.)

OPERATIONS.—1910-11-12. Omit "in w chan."

PROJECTS.—Omit "x 4,500' from sea to opposite Little Nahant," in Suter project.

(Page 84.)

WINTHROP HARBOR, MASS. (B-114)

Abstract should follow Boston H., Mass., abstract.

BOSTON HARBOR, MASS. (B-113)

TITLE.—Reference should be made also to B-117, and B-148.

COMMERCE.—Seventh paragraph should read as follows: "Increase in value since 1867; 1902, about $98,000,000, **03,** 78; 1911, over $122,000,000, **12,** 89.

(Page 85.)

CONTRACTS.—1903. George H. Breymann is correct. 1907. Breymann is correct.

(Page 88.)

OPERATIONS.—1904-05. On third line the price should be "79.5¢."

PROJECTS.—In paragraph headed "Tributary Channels," the second from the last line should read—"chan. 25' x 150' from 35' chan., Boston H., for". Paragraph referring to Mansfield proj. of 1894 (page 89), the chan. was to run from Grand Junction R. R. Br. to B. & M. Omit "head to navigation" in the third line.

(Page 89.)

SURVEYS.—Paragraph relating to Allerton Pt., 1905; the footnote reference should be footnote No. 5 instead of No. 1.

EAST BOSTON CHANNEL, MASS. (B-117)

SURVEYS.—First line should begin with "Ex. se.," omitting "sse."

(Page 90.)

CHELSEA RIVER, MASS. (B-118)

SURVEYS.—Right reference in last paragraph is to **95,** 648.

MYSTIC RIVER, MASS. (B-119)

CONTRACTS.—1912. "Bay State Dredging Co. (Ltd.)," is correct.

(Page 91.)

MYSTIC AND MALDEN RIVERS, MASS. (B-119 and 121)

APPROPRIATIONS.—**07,** 909 is an additional reference for item of 1905.

ENGINEERS IN CHARGE.—Lt. Col. G. L. Gillespie. See also report for **89,** 594. Lt. Col. Stanton. See **05,** 813, instead of 815.

(Page 92.)

DORCHESTER BAY AND NEPONSET RIVER, MASS. (B-132 and 134)

ENGINEERS.—Chief of Engineers. **07,** 62 is correct.

(Page 93.)

WEYMOUTH RIVER, MASS. (B-138)

TITLE.—No. should be B-138 and B-143.

CONTRACTS.—1912. Bay State Dredging Co. (Ltd.), dr., about 10,000 c. y., in Back R., 30½¢ c. y., **12,** 1399.

ENGINEERS IN CHARGE.—Lt. Col. G. L. Gillespie, 1888. **R., 90,** 521. Col. F. V. Abbot, **12,** 1397.

(Page 95.)

WEIR RIVER, MASS. (B-146)

ENGINEERS IN CHARGE.—Lt. Col. S. M. Mansfield, 1888-89.

COHASSET HARBOR, MASS. (B-150)

ENGINEERS IN CHARGE.—Lt. Col. S. M. Mansfield, 1888-89.

(Page 96.)

SCITUATE HARBOR, MASS. (B-151)

PROJECTS.—The footnote is No. 1, and refers to second to last paragraph.

(Page 98.)

PLYMOUTH BEACH AND HARBOR, MASS. (B-168)

ENGINEERS (Chief of Engineers).—Reference of **85,** 67 should include page 64.

ENGINEERS IN CHARGE.—Lt. Col. G. L. Gillespie, **89,** 596.

(Page 99.)

OPERATIONS.—1901-2. 13,728 t. st. placed "in," not "completing."

SURVEYS.—Ex. of 1894, Lt. Col. Mansfield, was made under act Aug. 17, 1894.

(Page 101.)

PROVINCETOWN HARBOR, MASS. (B-208)

ENGINEERS (Assistants).—W. T. Martin, **69,** 437 is correct.

(Page 103.)

STAGE HARBOR, MASS. (B-218)

ENGINEERS IN CHARGE.—Add Lt. Col. G. L. Gillespie.

C.—NEWPORT, R. I., DISTRICT.

(Page 107.)

SALT POND, MASS.
Should follow C-5 as C-5(a).

(Page 108.)

NANTUCKET AND VINEYARD SOUNDS, MASS. (C-2)
PHYSICAL CHARACTERISTICS.—Details, reference, first paragraph, **04**, 959.
SURVEYS.—Reference is to **04**, 952.

NANTUCKET SOUND, MASS. (C-3)
ENGINEERS (In charge).—Lt. Col. Sanford reference is **11**, 118.

(Page 109.)

BASS RIVER, MASS. (C-7)
SURVEYS.—Reference, last paragraph, is **00**, 1282.

HYANNIS HARBOR OF REFUGE, MASS. (C-9)
APPROPRIATIONS.—Reference after total is **12**, 1407.

(Page 111.)

WOODS HOLE HARBOR, MASS. (C-18)
OPERATIONS.—1902-3. 42 c. y. bowlders removed is correct.

LITTLE HARBOR, WOODS HOLE, MASS. (C-19)
ENGINEERS (In charge).—Reference to Lt. Col. Sanford is **10**, 93.
SURVEYS.—Insert, as a first paragraph, the following: Sur. au. act Aug. 7, 1894; made, 1895, by Lt. Harts, **95**, 750.

(Page 114.)

MARTHAS VINEYARD, MASS. (C-30)
PLANS.—The Warren estimate was $39,050, **82**, 578.
SURVEYS (Maps).—**95**, 662 is correct.

(Page 115.)

NANTUCKET HARBOR, MASS. (C-31)
ENGINEERS (Chief).—The 1911 report is at page 93.
PROJECTS.—The 1880 report, second paragraph, is at page 434.

(Page 117.)

WAREHAM HARBOR, MASS. (C-43)
COMMERCE.—The 1872 report is at pages, 94, 953, 974.
CONTRACTS.—1886. The price, Pidgeon, dr., was 13.95¢, **87**, 543.
ENGINEERS (In charge).—Maj. Warren's report for 1872 is at page 953.
OPERATIONS.—1875-77. The 1877 report is at page 195.

(Page 118.)

NEW BEDFORD, MASS. (C-53)
CONTRACTS.—1902. Page reference to Cole contract is **04**, 912.
ENGINEERS (Chief).—The page of the 1911 report is 97.

(Page 119.)

WESTPORT HARBOR, MASS. (C-59)
OPERATIONS.—1887-88. Improvement completed by construction of a jetty at Horse Neck Pt., **88**, 492.

SAKONNET RIVER, R. I. (C-63)
COMMERCE.—In 1907, 11,060 t., **08**, 982.

(Page 120.)

SAKONNET POINT HARBOR, R. I. (C-64)
SURVEYS.—Report on the Lockwood and Goethals survey is in **01**, 175, 1148.

(Page 121.)

COASTERS ISLAND HARBOR, R. I. (C-66)
TITLE.—Should be "Coasters Harbor Island."

NEWPORT HARBOR, R. I. (C-67)
CONTRACTS.—1875. Additional reference for Flannery contract is **76**, 208.

(Page 123.)

TAUNTON RIVER, MASS. (C-69)

APPROPRIATIONS.—Page reference for the 1894 item of $5,000 is **95**, 675.

(Page 124.)

PROJECTS.—The reference to the Bixby project, 1895, is **95**, 675.

FALL RIVER HARBOR, MASS. (C-70)

ENGINEERS (Chief).—The reference for the 1899 report is **99**, 91.

(Page 125.)

NARRAGANSETT BAY, R. I. (C-79)

ENGINEERS (In charge).—The 1901 reference in both cases is **01**, 1156.

(Page 126.)

PROVIDENCE RIVER, HARBOR, BULKHEAD ROCK, AND NARRAGANSETT BAY, R. I. (C-81)

ENGINEERS (In charge).—The 1907 report of Maj. Lockwood is **97**, 908. Omit the figures "908" after the 1896 reference.

CONTRACTS.—1870. Additional reference to the Hill contract is **71**, 727.

(Page 127.)

OPERATIONS.—1907-8. (Page 127.) The reference is to **08**, 983, 984.

(Page 128.)

PROVIDENCE RIVER, R. I. (C-81(a))

ENGINEERS (In charge).—The 1894 reference is to **94**, 592.

PAWTUCKET RIVER, R. I. (C-83)

CONTRACTS.—1902. The proper reference to the Packard contract is **03**, 800.

(Page 129.)

ENGINEERS (Assistants).—The page reference to Russell and Dager should be **71**, 735.

PHYSICAL CHARACTERISTICS. — Fifth paragraph: Mean rise of tide about 5′, **03**, 95.

(Page 130.)

PAWTUXET HARBOR, R. I. (C-84, 85, 86)

TITLE.—C-84, 85, 86 refer to the same work or place.

PAWTUXET COVE, R. I. (C-84)

ENGINEERS (In charge).—Col. Willard's report is **08**, 92.

(Page 131.)

POTOWOMUT RIVER, R. I. (C-92)

"Potonowut" is incorrect.

WICKFORD HARBOR, R. I. (C-93)

ENGINEERS (In charge).—Col. Willard's report is **08**, 97.

(Page 133.)

POINT JUDITH, R. I. (C-102)

APPROPRIATIONS.—The allotment of $10,000, in 1907, was made in 1903. Reference is as shown, **09**, 1020.

(Page 134.)

BLOCK ISLAND, R. I. (C-103)

APPROPRIATIONS.—Reference to the total is **12**, 1429.

(Page 135.)

SURVEYS.—The reference to Maj. Lockwood's report is **00**, 1277.

(Page 137.)

BLOCK ISLAND, R. I. HARBOR OF REFUGE. (C-104)

Congressional documents are listed in **04**, 84, instead of **01**, 84. They are referred to also at **01**, 173.

LITTLE NARRAGANSETT BAY, CONN. AND R. I. (C-106)

CONTRACTS.—The 1873 reference to the Molthrop contract is **78**, 244. The price, 1882, of the Hartford Dredging Co. contract for dr., was 20.9 ¢ per c. y., **83**, 498.

OPERATIONS.—1881-82. 33,683 c. y. were dredged, instead of 33,686, **82**, 563.

(Page 138.)

SURVEYS.—Map, **79**, 314.

D.—NEW LONDON, CONN., DISTRICT.

(Page 141.)

PAWCATUCK RIVER, R. I. AND CONN. (D-1)

Flows into Little Narragansett Bay.

STONINGTON HARBOR, CONN. (D-2)

Flows into Fishers Island Sound.

WEQUETEQUOCK RIVER, CONN. (D-3)

Flows into Little Narragansett Bay.

QUIAMBOG COVE, CONN. (D-4)

Flows into Fishers Island Sound.

MYSTIC RIVER, CONN. (D-5)

Flows into Fishers Island Sound.

POQUONOCK RIVER, CONN. (D-6)

Flows into Fishers Island Sound.

HAY (WEST) HARBOR, FISHERS ISLAND, N. Y. (D-10)

Flows into Fishers Island Sound.

WESTBROOK HARBOR, CONN. (D-24)

Flows into Long Island Sound.

MILL RIVER, CONN. (D-77)

In Conn. only.

FIVEMILE RIVER, CONN. (D-84)

Flows into Fivemile R. Harbor.

DARIEN RIVER (GOODWIVES CR.), CONN. (D-87)

Flows into Darien Harbor.

(Page 142.)

PAWCATUCK RIVER, R. I. AND CONN. (D-1)

CONTRACTS:

1897. Omit "or t." in third line.

1895. Randerson contract was for bowlder removal, not for rock removal.

1909. Omit "one about" from the second line.

ENGINEERS (Chief).—The report for 1886 is at **86**, 80. The 1902 report is at **02**, 123.

OPERATIONS:

1871-72. Omit "chan. (dimensions)."

1872-73. 5½′ to Westerly.

1873-74. Depth of chan. to Westerly increased to 5½′ x 75′.

1886-87. Reference is to **87**, 565.

1887-1888. 8 c. y. bowlders removed.

1896-97. 266 c. y. rock and bowlders removed.

1909-10. "Contract" should be "contracts."

(Page 143.)

PROJECTS:

In second paragraph, project is the project of 1885. Additional reference, **85**, 622.

The project for 10′, 1895, from Stonington H., was by Maj. Lockwood; and it was to be 100′ w., Avondale to Westerly. Additional reference, **96**, 676.

Additional reference for project for obstr. removal, under act Mar. 3, 1905, **05**, 94.

STONINGTON HARBOR, CONN. (D-2)

CONTRACTS:

1875. Contract was with J. S. Crosby, **76**, 223.

1879. Price, Ballou contract, 89.9—¢.

1881. Price of Ballou contract, $1.14½.

1882. Price of Ballou contract, $1.09 8/10.

1886. Price of Bouker contract, $1.02 3/10.

1889. Price of Stoll contract $1.07, not $11.07 pert.

DOCUMENTS.—Report of Lt. Prescott was to Lt. Col. J. G. Anderson.

(Page 144.)

ENGINEERS (In charge).—The 1884 report of Lt. Col. Elliot is at **84**, 630.

ESTIMATES.—BE., 1875. Additional estimate, $231,000.

OPERATIONS:

1879-80. 34,801 t. granite delivered in breakwater.

1881-82. 23,909 t. st. is correct.

1883-84. 4,986.5 t. riprap st. is correct.

1888-89. 3,664.5 t. riprap granite is correct.

PROJECTS.—First paragraph. Make last line read, "cost, $36,753.83, **72**, 918."

(Page 145.)

MYSTIC RIVER, CONN. (D-5)

ENGINEERS (Chief).—The 1891 report is **91**, 63.

ENGINEERS (In charge).—Col. Houston was Lt. Col. prior to the 1891 report.

PROJECTS.—The project of 1888 was by Lt. Col. Houston.

SURVEYS.—The examination of 1888 was by Lt. Col. Houston. The reference is 89, 746.

NEW LONDON HARBOR, CONN. (D-7)

ENGINEERS (In charge).—The 1889 report was the first rendered by Col. Houston as colonel.

(Page 146.)

THAMES RIVER, CONN. (D-11)

APPROPRIATIONS.—The reference to the 1899 appropriation is 99, 1156.

(Page 147.)

CONTRACTS.—1867. The reference is 71, 751, not 551.

ENGINEERS (In charge):

The first report of Maj. Houston, as major, was the 1867 report.

The first report of Lt. Col. McFarland as Lt. Col. was for 1884.

Capt. Waldron's report for 1912 is found at 12, 1436.

ESTIMATES.—In the fourth line of the Barlow estimate the aggregate should be $81,800.

OPERATIONS:

1866–67. The pages of the 1867 report are 45 and 448.

1871–72. 45,954 c. y. were dredged.

1872–73. The page of the 1873 report is 984.

1882–83. 53,197 c. y. were dredged.

1883–84. Omit the words "training wall completed," and insert "2,988 l. f. pile and riprap dike built at Mohegan."

1886–87. Insert the words "and in" after the semicolon, second line.

1888–89. 151,272 c. y. dr., not 222,392.

1907–08. 52,886 c. y. dr., not 74,340.

(Page 148.)

NIANTIC RIVER, CONN. (D-20)

ENGINEERS (Chief).—The page of the 1885 report is 96, not 963.

PLANS.—Make the last line read as follows—"l. w. below the R. R. br., and dr. above br.; est., $8,000, 85, 711."

(Page 149.)

CONNECTICUT RIVER, CONN., MASS. (D-23)

SUMMARY AT HEAD.—The period of Part a is 1829–1879.

Including miscellaneous, the total might be $958,481.59.

CONNECTICUT RIVER. (D-23-a)

APPROPRIATIONS.—1878. References, additional, 78, 247, and act June 20.

(Page 150.)

CONNECTICUT RIVER, BELOW HARTFORD, CONN. (D-23-b)

APPROPRIATIONS.—The total, including miscellaneous, $560,677.02.

CONTRACTS:

1881. In the first line, change "J. Beattie" to "E. H. Williams." In the third line, change "E. H. Williams" to "J. Beattie."

1882. E. H. Williams, riprap dike, $1.10 t., of st., 83, 509. H. N. and A. J. Beardsley, dr., 13¢ c. y., 83, 509.

1883. Hartford Dredging Co., dr., 11⅝¢ c. y., 83, 509.

1884. Add contract of C. C. Goodrich, dr., 10¢ c. y., 84, 641.

1886. Add contracts of C. C. Goodrich., dr., 10¢ c. y., 86, 627. C. C. Goodrich, dr., 87, 592.

1887. Hartford Dredging Co., dr., 87, 593.

1888. C. C. Goodrich, dr., 10¢ c. y., 88, 533.

(Page 151.)

ENGINEERS (Chief).—The 1897 report is on page 86.

ENGINEERS (In charge):

The first report of Col. McFarland as Lt. Col. was 1884.

The first report of Col. Houston as Col. was 1889.

OPERATIONS:

1881–82. 32,870 c. y. dr., not 9,017.

1882–83. 47,269 c. y. dr., not 31,433.

1883–84. Change the whole line to read "91,400 c. y. dr., 14,255 t. st. placed, 84, 640, 641."

1885–86. 1542 t. st. placed, not 1,582.

1886–87. Second line—6,289 t. st. placed, not 6,829.

1889–90. 45,377 c. y. dr., not 63,411.

1898–1900. 180,538 c. y. dr., not 99,883.

1900–1901. 50,961 c. y. dr., not 64,284.

1910–11. 103,521 c. y. dr., not 168,355.

1911–12. 137,825 c. y. dr., not 155,147.

PROJECTS:

The Warren estimate, 1879, should be $330,487.

The 1892 reference of the Houston project, 1889, is 92, 661.

(Page 152.)

CONNECTICUT RIVER, ABOVE HARTFORD, CONN. (D-23-c)

ENGINEERS (In charge):

First report of Col. McFarland as Lt. Col. was 1884.

First report of Col. Houston as Col. was 1889.

OPERATIONS.—Omit matter for 1881–82.

PROJECTS:

First paragraph.—Reference in the third line should be 71, 762, 763.

Fourth paragraph.—The estimate should be $1,465,000, not $1,564,000.

(Page 154.)

DUCK ISLAND HARBOR, CONN. (D-41)

CONTRACTS.—1896. The reference to the Quinn annulment is 98, 953.

CLINTON HARBOR, CONN. (D-44)

ENGINEERS (In charge):

First report of Col. McFarland as Lt. Col. was 1884.

First report of Col. Houston as Col. was 1889.

(Page 155.)

MADISON HARBOR, CONN. (D-47)

PLANS.—The locality in the second line should be "Madison," not "Milford."

(Page 156.)

BRANFORD HARBOR, CONN. (D-53)

SURVEYS.—The reference of the Leach survey is 01, 198.

NEW HAVEN HARBOR, AND WEST RIVER, CONN. (D-56)

SUMMARY.—The total, including miscellaneous items, might be $837,194.35, 12, 1447.

NEW HAVEN HARBOR, CONN. (D-56-a)

APPROPRIATIONS.—The allotment was the $3,000 item, 1907, not the $10,000 item.

CONTRACTS:

1872. The 1872 reference is 72, 863 only.

1873. The price of the Beardsley contract is 19.73¢.

ENGINEERS (In charge):

Maj. Houston rendered a report in 1869, 69, 409.

(Page 157.)

First report of Col. McFarland as Lt. Col., 1884.

First report of Col. Houston as Col., 1889.

The 1903 report of Maj. Powell is at 03, 839.

ENGINEERS (Assistants).—Babcock's 1874 report is at 74, ii, 258.

PLANS.—The 1889 plan was submitted by Lt. Col. Houston.

PROJECTS:

Second paragraph.—The 1871 reference in the second line should be 71, 85, 769.

(Page 158.)

Last paragraph.—Change the last three lines to read as follows: "e. side of Quinnipiac R. between Ferry St. and Grand Ave., in which existing d. was 6′ or more, 12, 152."

SURVEYS.—The right page of the 1871 reference is 71, 776.

(Page 159.)

NEW HAVEN, CONN. (D-57)

COMMERCE.—Fifth paragraph. Additional reference, 12, 157.

CONTRACTS.—1882. Price of Ballou contract, $1.14½.

ENGINEERS (In charge):

First report of Col. McFarland as Lt. Col., 1884.

First report of Col. Houston as Col., 1889.

OPERATIONS.—1880–81. 58,416 t. granite, etc., correct.

(Page 160.)

OPERATIONS:

1907–8. The west breakwater is referred to.

1908–9. West breakwater is referred to.

1909–10. West breakwater is referred to.

MILFORD HARBOR, CONN. (D-61)

APPROPRIATIONS.—Right total, including allotment of 1892, is $72,750.

(Page 161.)

ENGINEERS (In charge):

First report of Col. McFarland as Lt. Col., 1884.

First report of Col. Houston as Col., 1889.

OPERATIONS.—1888–89. Besides dr., there were jetty repairs.

SURVEYS.—An additional reference for the harbor lines survey, 1894, is 95, 471.

(Page 162.)

HOUSATONIC RIVER, CONN. (D-64)

APPROPRIATIONS:

The correct reference for the 1888 item is 88, 553.

The 1909 item of $5,000 was an allotment.

CONTRACTS:

1886. The Smith contract was for the removal of Drews Rock, not Davis Rock.

1889. Parrott contract annulled, 90, 633.

1890. Add, Hartford Dredging Co., hire of dr. plant, $9 per hr., 90, 633.

1909. Add, E. S. Belden & Sons, placing st., in dike, $1.43 per t., 09, 1041.

ENGINEERS (In charge):

First report of Col. McFarland as Lt. Col., 1884.

First report of Col. Houston as Col., 1889.

ESTIMATES.—The reference of the Edwards estimate is 71, 786. Omit page 711.

(Page 163.)

OPERATIONS:
1885–86. 17,812 c. y. dr., not 14,394.
1886–87. 34,076 c. y. dr., not 37,494. Add, 140 c. y. loose st. dr. at Washington B.
1891–92. Add, break'r repaired.
1893–94. Insert "dike" for "bank" in second line.
1896–97. 31,104 c. y. dr., instead of about 36,000.

PROJECTS.—Additional reference for the 1887 project, **88**, 554.

(Page 164.)

BRIDGEPORT HARBOR, CONN. (D–66)

CONTRACTS:
1875. Prices of the Seward contract were 16¢, 15¢, 10¢; not 12¾¢.
1878. Right reference is **79**, 349.
1879. Another price for Beardsley dr. was 8¢.

ENGINEERS (In charge):
First report of Maj. Houston as Maj., **68**, 750.
First report of Col. McFarland as Lt. Col., **84**, 651.
First report of Col. Houston as Col., 1889.

OPERATIONS.—1908–9. Omit the words "and basin" from the second to the last line.

PROJECTS:
Fourth paragraph. Should begin as follows—"By Maj. Barlow, dr. chan. to 12′ with w. of 300′; est., $62,200.80."
In paragraph at bottom of column beginning "By Maj. Leach, 1898," add "one and" before "one-eighth" in second line from bottom of page.

(Page 166.)

PROJECTS:
First line, first column. Should end with "and mainten. of the 3," not 4.
Fourth paragraph from top. The second line should end with "to within 1,500′ of head of dr."

SURVEYS.—Maps. Add, **89**, 696.

BLACK ROCK HARBOR, CONN. (D–72)

ENGINEERS (In charge).—First report of Col. Houston as Col., 1889.

(Page 167.)

SOUTHPORT HARBOR, CONN. (D–76)

COMMERCE.—Third paragraph. Additional reference, **10**, 1173.

ENGINEERS (In charge).—First report of Col. McFarland as Lt. Col., 1884.

(Page 168.)

WESTPORT HARBOR, AND SAUGATUCK RIVER, CONN. (D–79)

ENGINEERS (Chief).—Add, **79**, 56.

(Page 169.)

NORWALK HARBOR, CONN. (D–80)

COMMERCE.—The 1912 reference is **12**, 168, 1456.

CONTRACTS.—1904. J. P. Randerson, dr., 17½¢ c. y., **05**, 894.

ENGINEERS (In charge):
First report of Col. McFarland as Lt. Col., 1884.
First report of Col. Houston as Col., 1889.

OPERATIONS:
1879–80. 40,671 c. y. dr., not 45,519.
1885–86. 19,360 c. y. dr., not 34,824.
1907–8. Add, 4.52 c. y. r. removed.
1908–9. 159.03 c. y. r. removed, not 159,034.

(Page 170.)

SURVEYS.—Maps. Add, **82**, 622.

(Page 170.)

WILSON POINT HARBOR, CONN. (D–82)

OPERATIONS.—1899–91–92. 179,000 c. y. dr., not 54,026.

FOOTNOTE.—No. 4. Prior improvement of Wilson Point Harbor conducted as part of Norwalk Harbor.

(Page 171.)

FIVEMILE RIVER HARBOR, CONN. (D–85)

OPERATIONS.—1899. 13,000 c. y. dr., **99**, 119.

(Page 171.)

STAMFORD HARBOR, CONN. (D–93)

APPROPRIATIONS.—Reference to the 1888 item is **88**, 566.

(Page 172.)

ENGINEERS (In charge).—First report of Col. Houston as Col., 1889. His 1887 report is at page 618, not 61.

PHYSICAL CHARACTERISTICS. — Insert "ranges" for "range lights," second line.

(Page 172.)

COSCOB HARBOR AND MIAMUS RIVER, CONN. (D-95)

COMMERCE.—Tonnage, 1903, 7,250, instead of 7,000.

(Page 173.)

GREENWICH HARBOR, CONN. (D-97)

SURVEYS.—In third paragraph add 06, 1025.

E.—NEW YORK, N. Y., DISTRICT NO. 1.

(Page 176.)

MAPS.

At top, "Rouses Pt." should be "Rouse Pt."

At quarter page from top, Ticonderoga "Cr." should be "R."

(Page 177.)

WATERWAY LIST.

Pugsley Cr., N. Y. (E-20.) Is properly spelled "Pugsley."

Lake Meahayh, N. Y. (E-34.) Is properly spelled "Meahach."

Saugerties H. (E-63.) The name "Saugerties H." should precede "Esopus Cr.," and the latter should be in parentheses.

Little Monte, and Monte Bay. (E-83, and 84.) The proper spelling is "Monty."

Page 178.

Whalons B. (E-94.) Proper spelling is "Whalons."

St. Albans. (E-120.) This refers to St. Albans H. and B.

(Page 194.)

HUDSON RIVER, N. J. AND N. Y. (E-38-a)

PROJECTS.—Fourth paragraph. Fifth line from bottom. The reference should be 68, 718, 719; 86, 667.

(Page 203.)

LAKE CHAMPLAIN, VT. (E-79)

ENGINEERS (In charge).—The first report of Maj. M. B. Adams is for 1887, and the page is 2412, not 97, 2412.

F.—NEW YORK, N. Y., DISTRICT NO. 2.

(Page 215.)

GREAT SOUTH AND JAMAICA BAYS, N. Y. (F-48 AND F-79)

The tributaries referred to in the footnote.

(Page 217.)

FLUSHING BAY, N. Y. (F-5)

OPERATIONS.—1880-81. Channel is 65′ x 6,000′.

G.—NEW YORK, N. Y., DISTRICT NO. 3.

(Page 247.)

KILL VAN KULL, N. J. (G-3)

TITLE.—Make it "Kill Van Kull, N. Y. and N. J."

ENGINEERS (In charge).—Omit page 154 from the Livermore reference.

SURVEYS.—Col. Livermore's report is dated Apr. 25, 1906.

NEWARK BAY, N. J. (G-4)

TITLE.—Make it "Newark Bay, N. Y. and N. J."

(Page 250.)

PASSAIC RIVER, N. J. (G-16-d)

COMMERCE.—Add reference 12, 256 to last paragraph.

(Page 251.)

OPERATIONS:

1907–8. 1,007,985 c. y. dr., not 1,017,985.
1908–9. 1,158,763 c. y. dr., not 1,158, 963.

(Page 252.)

RARITAN BAY, N. J. (G-23)

ENGINEERS (In charge).—The proper reference to Col. Roessler is 10, 188.

OPERATIONS.—1903–4. Change quantity on second line to read 43,855 c. y.

(Page 253.)

FOOTNOTE.—No. 1 is H. D. 184, 58th, 2d.

(Page 258.)

RARITAN RIVER, N. J. (G-36)

APPROPRIATIONS.—The reference to the 1902 allotment is to 03, 944.

CONTRACTS.—1882. Reference to the Leary contract is 83, 674.

(Page 259.)

ENGINEERS (Chief).—The 1910 reference is 10, 201.

ENGINEERS (In charge).—The reference to Col. Roessler is 10, 188.

PROJECTS.—The reference in the last paragraph is 93, 1116.

(Page 260.)

SOUTH RIVER, N. J. (G-39)

OPERATIONS.—1909–10. 13,479 c. y. is correct in first line.

(Page 261.)

CHEESEQUAKE CREEK, N. J. (G-40)

CONTRACTS:

1910. Omit the words "completed June 3, 1911."
1912. Omit this paragraph.

OPERATIONS.—1906–7. Length of chan. is 1,800′, not 800′.

PHYSICAL CHARACTERISTICS. — Reference in the second paragraph is to 11, 230.

(Page 262.)

KEYPORT HARBOR, N. J. (G-43)

APPROPRIATIONS.—From 1902 to 1912, each item is an allotment.

(Page 265.)

SHREWSBURY RIVER, N. J. (G-48)

ENGINEERS (In charge):

Lt. Col. N. Michler, 1880–1882.
Col. W. T. Rossel, 1910–.

OPERATIONS.—1901–2. 12,590 c. y. sand dr.

H.—PHILADELPHIA, PA., DISTRICT.

(Page 271.)

DELAWARE RIVER. (H-3)

SUMMARY.—Part b. Title should be "Above and below Trenton."

(Page 272.)

DELAWARE RIVER. (H-3-a)

APPROPRIATIONS.—Add a seventh footnote, to read, "Includes also removal of piers in Delaware River, back of Reedy Island, act Aug. 2, 1882." This refers to appropriation of 1883 at foot of page for Ice Harbor.

(Page 273.)

DELAWARE RIVER, N. J., PA., DEL. (H-3-b)

TITLE.—Omit the words "Trenton to Mouth." The abstract refers to the whole river, above and below Trenton.

(Pages 274, 275, 276.)

ENGINEERS (Chief of).—Add, **84**, 138 (Port Jervis ex.).

ENGINEERS (In charge).—Add to Weitzel reports, **84**, 855 (Port Jervis ex.).

ENGINEERS (Assistants).—Add, E. A. Giesler, **84**, 855 (Port Jervis ex.).

(Page 276.)

PHYSICAL CHARACTERISTICS.—Port Jervis to Trenton—130 miles by water. River bed of entire stretch of mountainous character. Description of sections, Port Jervis to Delaware Water Gap; to Easton; to Trenton. Floods frequent, and rises high. Details. **84**, 855.

(Page 277.)

SURVEYS.—Trenton to Port Jervis. Ex. au. act Aug. 2, 1882; made under Lt. Col. G. Weitzel, by E. A. Giesler. R. (unfav.), dated Dec. 12, 1882. (See Physical Characteristics.) **84**, 855. (Sen. Ex. 30, 48th, 1st.)

I.—WILMINGTON, DEL., DISTRICT.

(Page 299.)

WATERWAY LIST.

Little Egg Harbor, N. J. (I-9.) Omit "Inlet." Flows into New Inlet, I-11, not into I-2.

Cedar Cr., Del. (I-71.) Flows into Mispillion R. (I-70), not into Delaware Bay.

(Page 303.)

ATLANTIC CITY HARBOR, N. J. (I-17)

SURVEYS.—Second paragraph should read as follows: "Au. act Aug. 5, 1886; made by BE., 1886, **87**, 815.

(Page 315.)

WILMINGTON HARBOR, DEL. (I-58)

CONTRACTS.—1908. Emil F. Petterson is correct.

J.—BALTIMORE, MD., DISTRICT.

(Page 356.)

CHESTER RIVER, MD. (J-413)

PROJECTS.—"Crampton" throughout should be "Crumpton."

SURVEYS:

"Rirby's to Spry's Landing" should be "Kirbys to Sprys Landing."

"Crampton" should be "Crumpton."

K.—WASHINGTON, D. C., DISTRICT.

(Page 373.)

WATERWAY LIST.

Picowaxton Cr., Md. (K-73.) Spelled with one "c" only.

(Page 374.)

Neabsco Cr., Va. (K-108.) Not "Neabsico."

Currioman B., Va. (K-117.) Flows into K-116, or Nomini B.

Lockies Cr., Va. (K-229.) Spelled "Locklies."

(Page 375.)

Sibleys Cr., Va. (K-275.) Not "Sipleys."

(Page 395.)

NOMINI CREEK, VA. (K-118)

ENGINEERS (Chief of).—The 1895 report is at 95, 161.

L.—NORFOLK, VA., DISTRICT.

(Page 412.)

WATERWAYS LIST.

College Cr., Va. (L-113.) Same as L-116, or Archers Hope R. See below.

Archers Hope R. (L-116.) Same as L-113. See above.

(Page 413.)

Nawneys Cr., Va. (L-237.) Spelled as such on U. S. C. S., not "Nanneys."

Joyces Cr., N. C. (L-270-a.) Add to list with number shown. Tributary to (264).

(Page 414.)

CAPE CHARLES CITY HARBOR, VA. (L-62)

ENGINEERS (Assistants).—Stierle's report is 90, 972, 976.

(Page 419.)

JAMES RIVER, VA. (L-105)

CONTRACTS.—1887. The second contract was with J. L. Johnson, not "Wilson."

(Page 420.)

ENGINEERS (Chief).—The 1872 report is at 72, 69. Add, report for 09, 269.

(Page 421.)

OPERATIONS:

1890–91. The reference is **91**, 1239–1240.

1910–11. The reference is **11**, 1474–1477.

1911–12. The reference is **12**, 1710–1714.

(Page 422.)

SURVEYS.—The 1870 reference is also on page 31, or **70**, 31. Maps.—(See also **76**, 292, and 298.)

(Page 425.)

APPOMATTOX RIVER, VA. (L-150)

CONTRACTS:

1884. Last contract was with A. F. Hall, not "Hull."

1886. Reference is **87**, 979.

ENGINEERS (Chief).—Report for 1873 is **73**, 75.

ENGINEERS (In charge).—Add to Craighill reports, **70**, 68; **71**, 606; **72**, 692.

(Page 426.)

PHYSICAL CHARACTERISTICS:

In second to last paragraph reference is **12**, 407.

In last paragraph reference is **12**, 410.

PRIVATE WORK.—In paragraph relating to construction of dredge by Petersburg, the 1884 reference is **84**, 915.

(Page 427.)

SURVEYS.—Second paragraph. Add, **70**, 31.

(Page 428.)

NANSEMOND RIVER, VA. (L-165)

CONTRACTS.—1903. Add, **04**, 1369.

(Page 429.)

ELIZABETH RIVER, VA. (L-173)

ENGINEERS (In charge).—Omit from Abert reports, **75**, ii, 110.

ESTIMATES.—In Abert estimate of 1875 the reference is **75**, 93; ii, 127.

(Page 430.)

NORFOLK HARBOR, VA. (L-173-b)

APPROPRIATIONS.—Item of $187,500 (1886) has reference **86**, 952, 957.

(Page 431.)

CONTRACTS.—1886. Last reference is **87**, 968.

ENGINEERS (Assistants).—Add to Phillips reference, **72**, 716.

OPERATIONS.—1889–90. There is some doubt about this quantity being dredged. (See **90**, 1023, and 104, 105, 333.)

(Page 437.)

NORFOLK HARBOR TO ALBEMARLE SOUND. (L-173-i)

PROJECTS.—Last line of Hinman paragraph should read "est., $65,122, **85**, 159, ii, 1040."

(Page 438.)

DISMAL SWAMP CANAL, VA. (L-173-o)

PHYSICAL CHARACTERISTICS.—Reference, third paragraph is **96**, 1090.

(Page 442.)

EDENTON BAY AND HARBOR, N. C. (L-296)

COMMERCE.—Reference in second paragraph is **06**, 1139.

(Page 443.)

ESTIMATES.—Reference in first paragraph is **73**, 856, 857.

OPERATIONS.—1884–85. Reference is **84**, 1038.

PHYSICAL CHARACTERISTICS.—First line of first paragraph should be "Description of, **73**, 857; **76**, 358, 359."

(Page 444.)

BLACKWATER RIVER, VA. (L-312)

APPROPRIATIONS.—Reference to total is **12**, 1727.

(Page 446.)

ROANOKE RIVER, N. C. AND VA. (L-352)

ENGINEERS (In charge).—Add to Craighill reports, **70**, 69.

ESTIMATES.—Last reference of last paragraph should be **79**, 625.

OPERATIONS.—1878–1888. 2,282 logs removed, not 2,272.

SURVEYS.—Add to Craighill reference, **70**, 31, and omit pages 71 and 76.

(Page 448.)

DAN RIVER, N. C. AND VA. (L-378)

ENGINEERS (In charge).—The 1887 reference is **87**, 953.

(Page 449.)

PROJECTS.—The 1886 reference in the last line is **86**, 146.

M.—WILMINGTON, N. C., DISTRICT.

(Page 458.)

SHALLOWBAG BAY, N. C. (M-21)

APPROPRIATIONS.—The reference of the 1910 appropriation is **10**, 1401.

(Page 468.)

CONTENTNIA CREEK, N. C. (M-172)

OPERATIONS.—1881-82. The 1882 reference is **82**, 1092.

(Page 470.)

TRENT RIVER, N. C. (M-180)

OPERATIONS.—1908-9. The 1909 reference is **09**, 1280.

(Page 471.)

CORE SOUND, N. C. (M-226)

COMMERCE.—The 1893 reference should be **95**, 1374.

(Page 473.)

BEAUFORT HARBOR, N. C. (M-257-a)

PROJECTS.—The reference to the 1907 authorization (fifth paragraph) is **09**, 301.

(Page 476.)

BEAUFORT HARBOR, N. C. (M-257-e)

ENGINEERS (Chief).—The 1892 reference is **92**, 162.

(Page 477.)

PHYSICAL CHARACTERISTICS.—The 1902 reference in the third paragraph is **02**, 282.

NEWBERN TO BEAUFORT, N. C. (M-257-f)

ENGINEERS (Chief).—The 1882 reference in the third line should be **92**, 161.

(Page 478.)

OPERATIONS.—1887-88. The reference is **88**, 872.

(Page 482.)

NEW RIVER TO SWANSBORO, N. C. (M-286)

ENGINEERS (Assistant).—W. H. Chadbourn, jr., not H. W.

(Page 483.)

NEW RIVER, N. C. (M-290)

OPERATIONS.—1895-1906. Cedar Bush Cove is correct.

PROJECTS.—The 1882 reference in the first paragraph is **82**, 1117.

(Page 485.)

CAPE FEAR RIVER, N. C. (M-305-a)

CONTRACTS:

1883. The 1884 reference to the Summerell contract is **84**, 939.

1884. The references to the Moore contract should be **85**, 1089, and **86**, 1012.

ENGINEERS (Boards).—In the third paragraph the 1873 reference should be **73**, 809, 810.

(Page 491.)

NORTHEAST CAPE FEAR RIVER, N. C. (M-306)

PHYSICAL CHARACTERISTICS.—The 1912 reference in the last paragraph should be **12**, 452.

N.—CHARLESTON, S. C., DISTRICT.

(Page 505.)

GREAT PEDEE RIVER, N. C. AND S. C. (N-19)

CONTRACTS.—1904. Merrill-Stevens is correct.

(Page 518.)

CHARLESTON HARBOR, AND ALLIGATOR CREEK, S. C. (INLAND WATERWAYS). (N-202-b)

PROJECTS.—Fourth paragraph from bottom of "Projects" on page 521 belongs on page 518, in "Projects" of (N-202-b)

SURVEYS.—Third paragraph from bottom of page 521 (Surveys) belongs on page 518, under "Surveys" of (N-202-b)

(Page 520.)

CHARLESTON HARBOR, S. C. (N-203)

OPERATIONS.—1885-86. Last reference is 86, 176.

PROJECTS AND SURVEYS.—See above (N-202-b)

(Page 524.)

ASHLEY RIVER, S. C. (N-214)

ESTIMATES.—"By Lt. Col. Gillmore" is correct.

(Page 528.)

SALKEHATCHIE RIVER, S. C. (N-255)

PHYSICAL CHARACTERISTICS. — "Salkehatchie" is correct.

O.—SAVANNAH, GA., DISTRICT.

(Page 533.)

WATERWAY LIST.

The list from O-77 to O-82 might be arranged preferably as follows:

O-77 South Chan., Ga. (2)
O-78 St. Augustine Cr., Ga. (77)
O-79 Wilmington R., Ga. (78)
O-80 Habersham Cr., Ga. (79)
O-81 Richardson Cr., Ga. (79)
O-82 Turners Cr., Ga. (79)

Wassaw Sound, Ga. (O-86.) Not "Warsaw."
Wassaw Cr., Ga. (O-104.) Not "Warsaw."

(Page 534.)

Pico Cut, Ga. (O-231.) Not "Cr."

(Page 536.)

Todds Cr., Ga. (O-500.) Not "Toods."

(Page 538.)

SAVANNAH RIVER AND HARBOR, GA. (O-2-a)

PLANS.—Last line of last paragraph. Change name to "Trotters Shoal."

(Page 540.)

SAVANNAH HARBOR, GA. (O-2-b)

ENGINEERS (Assistants).—Capt. B. D. Greene is correct. E. A. Gieseler is correct.

(Page 556.)

OCMULGEE RIVER, GA. (O-326)

ENGINEERS (Assistants).—J. L. Van Ornum is correct.

(Page 560.)

BRUNSWICK HARBOR, GA. (O-443)

ENGINEERS (Assistants).—S. L. Fremont is correct.

(Page 563.)

CUMBERLAND SOUND, FLA. AND GA. (O-501)

OPERATIONS.—1884-85. "South jetty," instead of "Smith Jetty."

(Page 565.)

ATLANTIC OCEAN-WATERWAY ACROSS FLA. (O-510-b)

(See also P-1-a, on page 572.)

The data on pages 565 and 566 relating to waterways between the Gulf of Mexico and to waterway between St. Marys, Ga., and St. Johns, Fla., might, perhaps, be better assembled with the matter for the succeeding or P-District.

(Page 566.)

ST. MARYS RIVER TO GULF OF MEXICO, FLA. (O-510-c)

ENGINEERS (Assistants).—S. L. Fremcnt is correct.

P.—JACKSONVILLE, FLA., DISTRICT.

(Page 572.)

ATLANTIC OCEAN TO GULF OF MEXICO. (P-1-a)

See also page 565, or (O-510-b).

The waterway across to the Gulf of Mexico might be placed properly with the works of the Jacksonville District.

(Page 574.)

LOUISIANA AND TEXAS WATERS (HYACINTHS). (P-1-d)

OPERATIONS.—1902-3. "SS. Ramos fitted," not filled.

(Page 576.)

ST. JOHNS RIVER, FLA. (P-10-a)

Right number is as shown above.

(Page 577.)

ENGINEERS (In charge).—"Lt. A. M. D'Armit" is correct.

ENGINEERS (Assistants).—"Lt. A. M. D'Armit" is correct.

(Page 581.)

ST. JOHNS RIVER, FLA. (P-10-f)

CONTRACTS.—1886. J. A. Bryan is correct.

OPERATIONS.—1880-81. 1,950 is correct.

(Page 583.)

WEKIVA RIVER, FLA. (P-60)

Correct spelling is as shown above.

(Page 585.)

CAPE CANAVERAL HARBOR, FLA. (P-110)

Correct title and number is as shown above.

(Page 589.)

KEY WEST HARBOR, FLA. (P-200)

OPERATIONS.—1911-12. 240,441 c. y. dr. on or from outer shoal is preferable.

(Page 596.)

TAMPA BAY, FLA. (P-288-a)

CONTRACTS.—1887. R. Moore is correct.

(Page 598.)

HILLSBORO BAY, FLA. (P-288-c)

APPROPRIATIONS.—Reference in total should be to (P-288-a).

(Page 603.)

PITHLACHASCOOTIE RIVER, FLA. (P-329)

Correct spelling is as shown above.

(Page 606.)

CEDAR KEYS HARBOR, FLA. (P-349)

ENGINEERS (In charge).—Capt. A. N. Damrell is correct.

Q.—MONTGOMERY, ALA., DISTRICT.

(Page 610.)

MAP.

Chattooga R. (At head of map.)
Correct spelling as above.
Choctawhatchee Bay. (Near bottom.)
Correct spelling as shown above.
Chattahoochee R. (Near center of map.)
Correct spelling as shown above.

(Page 611.)

AUCILLA AND WACISSA RIVERS, FLA. (Q-5)

COMMERCE.—Reference is to 82, 1302.

ENGINEERS (Assistants).—Reference to Robinson report is 82, 1303.

(Page 612.)

PLANS.—Second line, second paragraph. Change $500 to $300.

WAUKULLA RIVER, FLA. (Q-11)

ENGINEERS (In charge).—Add, Capt. H. O. Ferguson, 08, 369.

PHYSICAL CHARACTERISTICS.—Reference is to 87, 1260.

SURVEYS.—Substitute "Ferguson" for "Cavanaugh" in last line.

OCKLOCKONEE RIVER, GA. AND FLA. (Q-13)

PHYSICAL CHARACTERISTICS. — Substitute "Rafts" for "rocks" in second line.

(Page 613.)

CROOKED RIVER, FLA. (Q-14)

ENGINEERS (Chief of).—The 1882 reference is 82, 186.

ST. GEORGES SOUND, FLA. (Q-15)

ENGINEERS (In charge).—Reference is 06, 333.

(Page 615.)

APALACHICOLA BAY, FLA. (Q-20)

OPERATIONS.—1884-85. Reference is to 85, 1259, 1261.

(Page 616.)

APALACHICOLA RIVER, FLA. (Q-21)

ENGINEERS (Chief).—1878 reference is 78, 80. The 1880 reference is 80, 135, 141.

ENGINEERS (In charge).—The Damrell report for 1882, right reference is 82, 1264, 1304.

(Page 617.)

OPERATIONS.—1889-90. 364 logs and snags is right.

PROJECTS:

Second paragraph. Omit "Proj. accomplished in 1880 by expend. of $37,244, 80, 1076."

Third paragraph. "Wewahitchka" is correct.

(Page 619.)

CHATTAHOOCHEE AND FLINT RIVERS, ALA., FLA., AND GA. (Q-23-a)

APPROPRIATIONS.—Omit 1879 reference from first 1878 item.

ENGINEERS (Assistant).—The Robinson reference is 79, 820.

OPERATIONS.—1878-79. The reference is 79, 101, 815.

(Page 620.)

CHATTAHOOCHEE RIVER, ALA. AND GA. (Q-23-b)

ENGINEERS (Chief).—The 1881 reference is 81, 181.

OPERATIONS:

1879-80. Add "and overhanging trees" after "51 snags."

(Page 621.)

1890-91. 414 c. y. marl, not 166 c. y.
1897-98. Reference is 98, 1388, 1389.
1910-11. Reference is 11, 1676.
1911-12. Reference is to 12, 583, 1893.

PLANS.—First paragraph. Reference is to 80, 1707, 1721.

PROJECTS.—Second paragraph. Reference is to 99, 1662.

(Page 622.)

FLINT RIVER, GA. (Q–23–c)

OPERATIONS:

1882–83. 4,204 trees and snags is correct.

1911–12. Reference is **12**, 582, 1891.

(Page 625.)

CHOCTAWHATCHEE RIVER, FLA. AND ALA. (Q–32)

APPROPRIATIONS.—Item of 1844 has reference "act June 15."

COMMERCE.—The last paragraph should read as follows: "With the exception of movement of logs, there is no C. above the mouth of Holmes R. The value of the general C. below that point valued at about $2,000,000 per annum."

ENGINEERS (In charge).—Col. Fitch's 1912 report is **12**, 1898.

(Page 626.)

OPERATIONS.—1904–5. Last line should read "below mouth of Holmes R., **05**, 1335."

(Page 627.)

LAGRANGE BAYOU, FLA. (Q–33–b)

APPROPRIATIONS:

Reference to the 1882 item is **83**, 1001.

Item of 1886 is an allotment.

ENGINEERS (In charge).—The 1886 report of Capt. Hoxie is at **86**, 1178.

OPERATIONS.—1890–91. 185 snags removed is correct; omit "from the banks."

PROJECTS.—First paragraph. Insert comma after 4½′, and word "depth" after "existing."

HOLMES RIVER, FLA. (Q–33–c)

APPROPRIATIONS:

1909 item is an allotment.

1910 item has reference **10**, 1544.

1911 item has reference **11**, 1683.

ENGINEERS (In charge):

Craighill reference, **07**, 347.

Jervey reference, **07**, 347.

Ferguson reference, 1910, **10**, 1543.

(Page 628.)

PENSACOLA HARBOR, FLA. (Q–38)

CONTRACTS.—1900. Price is R. Moore contract, 16¢, not 15¢.

ENGINEERS (Chief of).—The 1887 reference is **87**, 164, 171.

(Page 629.)

ENGINEERS (In charge).—Capt. Hoxie's report for 1885 is at **85**, 1313.

OPERATIONS:

1882–83. McRee is correct.

1883–84. "st. protection" should be "shore protection."

1884–85. Fifth line. Substitute "end" for "and inner 15′."

PROJECTS:

Second paragraph. McRee is correct.

Third paragraph. $81,446 is correct, in last line.

Second to last paragraph. Make reference **02**, 288, 1268.

(Page 630.)

BLACKWATER RIVER, FLA. AND ALA. (Q–41)

PROJECTS:

Raymond project dimensions. "9′ x 100′" is correct.

Last paragraph. Reference is **10**, 449, 450.

(Page 631.)

CONECUH RIVER, ALA. (Q–43–b)

PLANS.—Correct amount in third line is "$241,685."

ESCAMBIA AND CONECUH RIVERS, FLA. AND ALA. (Q–43–c)

APPROPRIATIONS.—Item of 1910 is an appropriation, not an allotment.

ENGINEERS (In charge).—Capt. Price's report for 1891 is at **91**, 1735.

(Page 632.)

ESCAMBIA AND CONECUH RIVERS, FLA. AND ALA. (Q–43–c)

OPERATIONS:

1906–7. Derrick boat 75% completed.

1908–9. 3,266, instead of 1,666, obstructions removed. Reference is to **09**, 1399, 1400.

1910–11. Insert "logs" for "stumps."

PATSALIGA RIVER, ALA. (Q–44)

PHYSICAL CHARACTERISTICS. — Reference in second line is to **79**, 850, 851.

(Page 633.)

ALABAMA RIVER, ALA. (Q–49)

ENGINEERS (Chief of).—The 1879 report is at **79**, 103.

OPERATIONS:

1879–80. Reference is to **80**, 1083.

1889–90. 4,218 trees and stumps is correct.

1891–92. 25 c. y. bowlders is correct.

1892–93. 230 c. y. bowlders is correct.

(Page 634.)

1896–97. Reference is **97**, 1635, 1636, 1637.
1897–98. 2,000 obstructions is correct.
1909–10. 28,396 c. y. is correct.

(Page 635.)

COOSA RIVER, ALA. AND GA. (Q–52)

NOTE AT HEAD.—Reference is **12**, 599, 600.

(Page 636.)

COOSA RIVER, ALA. AND GA. (Q–52–a)

APPROPRIATIONS:

All appropriations under "Coosa R., Ala. and Ga.," since 1888 should be listed under heading "Coosa River between Rome, Ga., and East Tennessee, Virginia & Georgia Railroad Bridge."

Omit reference to pages 1430, 1678, and 1422 from items of 1892, 1894, and 1896, respectively, "Coosa River, Ala. and Ga."

In table "Coosa R. between Wetumpka and East Tenn., Va. & Ga. R. R. br.," omit page 1427 from item of 1892, and page 1417 from item of 1896.

In table "Coosa R., Ala. and Ga., operation and care of canals," reference to item of 1909 is to page 1406.

Footnote (6) refers to between Rome, Ga., and Dam No. 4, Ala.

(Page 637.)

ESTIMATES.—Long estimate, 1872. Reference is to **72**, 541–543.

OPERATIONS:

1880–81. Second line. 12,654 is correct.
1888–89. Third line. 2,105 c. y. stone is correct.
1894–95. Second to last line. 17,251, not 8,199, is correct.

PHYSICAL CHARACTERISTICS.—The 1871 reference is **71**, 563–570.

(Page 638.)

PROJECTS:

Third paragraph. Reference is **78**, 764–766.

Fourth paragraph. The 1889 reference is to **89**, 1390, 1391, 1393.

Paragraph beginning "Act Sept. 19." Estimate is $6,038,219, and reference is to **91**, 1744, 1747–1752.

COOSA RIVER, BETWEEN ROME, GA., AND EAST TENNESSEE, VIRGINIA & GEORGIA RAILROAD BRIDGE. (Q–52–c)

APPROPRIATIONS.—Reference is to (Q–52–a)

(Page 639.)

COOSA RIVER, GA., WETUMPKA TO EAST TENNESSEE, VIRGINIA & GEORGIA RAILROAD BRIDGE. (Q–52–d)

PROJECTS.—First paragraph. Reference is to **02**, 1276, 1277.

(Page 640.)

COOSA RIVER, ALA. AND GA. (OPERATION AND CARE OF CANALS.) (Q–52–e)

OPERATIONS.—1905–6. Omit words "upper and lower."

FOOTNOTE NO. 3.—Act Mar. 3, 1909, is referred to.

ETOWAH RIVER, GA. (Q–53)

ENGINEERS (In charge).—Reference, Col. Fitch, is **12**, 605.

(Page 641.)

SURVEYS:

First paragraph. Reference is to **72**, 480, not 481.

Third paragraph. Add reference, **77**, 603.

OOSTENAULA AND COOSAWATTEE RIVERS, GA. (Q–54–a)

ENGINEERS (Chief).—The 1874 reference is **74**, 70.

PROJECTS.—Last paragraph. Reference is to **03**, 305, 306.

(Page 642.)

CAHABA RIVER, ALA. (Q–60)

OPERATIONS.—1891–92. 1,558 l. f. willow j. constructed.

R.—MOBILE, ALA., DISTRICT.

(Page 647.)

MOBILE BAR, ALA. (R-3)
See also Mobile Harbor.

(Page 650.)

MOBILE RIVER AND HARBOR, ALA. (R-21)
PROJECTS.—First paragraph. Chan. dimensions are 10′ x 200′.

(Page 661.)

BLACK WARRIOR, WARRIOR, AND TOMBIGBEE RIVERS, ALA. (R-23-m)
APPROPRIATIONS.—1900. Reference is to 00, 2175.

(Page 666.)

PASCAGOULA RIVER AND HORN ISLAND HARBOR, MISS. (R-63-c)
CONTRACTS.—1899. A. G. Delmas is correct.

(Page 668.)

CHICKASAHAY RIVER, MISS. (R-66)
COMMERCE.—Last paragraph. Add reference 11, 1722.

(Page 670.)

BILOXI BAY AND HARBOR, MISS. (R-83)
ENGINEERS (Chief).—The 1882 report is 82, 186.

(Page 672.)

GULFPORT TO SHIP ISLAND HARBOR, MISS. (R-87)
OPERATIONS.—1907-1912. Quantities are in round numbers.

(Page 673.)

JORDAN RIVER, MISS. (R-92-a)
PHYSICAL CHARACTERISTICS.—Second line. "Empties into the ne. extremity" is correct, not "nw."

(Page 674.)

PEARL RIVER, MISS. (R-98-a)
OPERATIONS.—1910-11. Third line. Omit "1.2" before "m. l. w."

(Page 675.)

PEARL RIVER, MISS. (R-98-c)
ENGINEERS (In charge):
The 1893 report is 93, 1774, 1792.
The second 1892 reports refers to the 1893 reports.
OPERATIONS.—1885-86. At the end of the first line, make "any" into "and," and at the end of the second line, make "clad" into "clay."

(Page 676.)

PEARL RIVER, MISS. (R-98-d)
OPERATIONS.—1884-85. 10,812 snags, etc., is correct.

S.—NEW ORLEANS, LA., DISTRICT.

(Page 680.)

MAP.

Jeanerette and New Iberia. Transpose these titles on the map, page 680, just above Vermilion Bay.

(Page 681.)

WATERWAYS LIST.

Bayou Liberty. (S–11.)
Has only one tributary connection, S–10.

(Page 682.)

Bayou Maxent. (S–147.)
Change name to "Bayou Chaperon."

Lake Borgne Canal. (S–149.)
Last tributary connection is 244, and not 314.

Bayou Centilly. (S–188.)
Change name to "Bayou Gentilly."

(Page 683.)

Adams B. (S–328.)
Change name to "Bay Adams."

(Page 684.)

Cay B. (S–337.)
Change name to "Cat."

Bayou Chevreuil and Bayou Tigre. (S–384.)
Bayou Tigre is a tributary of Bayou Chevreuil.

Lake Boeuf Canal, La. (S–392.)
Change name to "Lake Boeuf Drainage Canal, La."

Bay des Illettes. (S–407.)
Change name to "Ilettes."

Harvey Canal. (Under S–422.)
Is the same as 398, and not 419. Flows as a connection of 419.

Bayou Lourse. (Under S–422.)
Is the same as 410, and not 419. Is a connection of 419.

Bayou Leau. (S–429.)
Change name to "L'Eau."

Dresser Canal. (Under S–430.)
Is the same as 425, and is a connection of 429.

(Page 685.)

Bayou Cane. (S–448.)
Change name to "Bayou Cane, or Whiskey Bayou, La."

Bay Challand. (S–453.)
Change name to "Bay Challaud."

Bayou L'Curse. (S–467.)
Change name to "Bayou L'Ourse."

Bayou Mellow. (S–506.)
Change name to "Bayou Milhomme."

Bayou de Claise. (S–541.)
Change name to "Bayou des Glaise."

(Page 686.)

Bayou Currant. (S–578.)
Change name to "Bayou Current."

Bayou Bellsire. (S–646.)
Change name to "Bayou Bellaire."

(Page 687.)

Bayou Yokely. (S–689.)
Change name to "Bayou Yokely, La., or Choupique."

Bayou Cypremort. (S–697.)
Tributary connection is 696.

Jeanerette Canal. (S–702.)
Change to "Weeks Canal."

Weeks Canal. (S–704.)
Change to "Jeanerette Canal."

Mallard B. (S–752.)
Tributary connection is 751.

Bayou Nezpiqué. (S–769.)
Spelled with accent over final "e."

(Page 688.)

North American. (S–784.)
Correct name is "North American Land & Timber Co."

Mud Lake. (S–863.)
Correct No. is 862.

(Page 689.)

CASTAING BAYOU. (S-17)
Ex. of 1911 unfavorable. See H. D. 251, 63d, 1st.

(Page 690.)

CHEFUNCTE RIVER. (S-20)

ASSISTANTS.—Mr. Ripley's initials are "H. C."

(Page 692.)

PONCHATOULA RIVER. (S-53)

Ex. of 1911 unfavorable. See H. D. 1117, 62d, 3d.

(Page 694.)

CARONDELET CANAL. (S-135)

The passage was by way of "Bayou St. John."

(Page 697.)

PLAQUEMINE BAYOU. (S-298)

OPERATIONS.—1911-12. The second line of the paragraph refers to 1,300 feet dr. by U. S.

(Page 700.)

LAFOURCHE BAYOU. (S-419)

PRIVATE WORK.—The date on second line of paragraph should be June 13, 1902.

(Page 702.)

ATCHAFALAYA BAY. (S-490-a)

SURVEYS.—Report by BERH., Sept. 8, 1908. The sixth line of paragraph should read "will reimburse the original expend."

(Page 704.)

COURTABLEAU BAYOU. (S-585)

SURVEYS.—Ex. and sur. of 1909. R. unfavorable. See H. D. 1056, 62d, 3d.

(Page 712.)

QUEUE DE TORTUE, LA. (S-756)

SURVEY.—Footnote reference marked (1) should be (2), to H. D. 609, 61st, 2d.

T.—DALLAS, TEX., DISTRICT.

(Page 717.)

WATERWAY LIST.

Sabine Pass, La. and Tex. (T-2)
Connected with Port Arthur Ship Canal.

Sabine and Neches Canal, Tex. (T-7)
Connected with Port Arthur Ship Canal.

Port Arthur Ship Canal, Tex. (T-8)
Connected with Sabine and Neches Canal, Tex.

SABINE LAKE, LA. AND TEX. (T-3)

SUMMARY.—Period begins with 1892.

The footnote to T-2 refers only to some of the tributaries of Sabine Pass, and principally on the east shore. The following list should be substituted for the list at the bottom of page 717:

T 2 (a) Sabine Pass, La. and Tex. (1)
(b) Sabine Lake, La. and Tex. (a)
(c) Pat Glennon Bayou, La. (b)
(d) Johnsons Bayou, La. (b)
(e) Deep Bayou, La. (d)
(f) Shallow Bayou, La. (d)
(g) Three Bayous, La. (b)
(h) Sabine River, La. and Tex. (a)
(i) Black Bayou, La. (h)
(j) Intracoastal Canal, La. (h)
(k) Vinton Canal, La. (h)
(l) Conways Bayou, La. (h)
(m) Choates Creek, La. (h)
(n) Caney Creek, La. (h)
(o) Brush Creek, La. (h)
(p) Bridge Creek, La. (h)
(q) Trout Creek, La. (h)
(r) Bayou l'Anacoco, La. (h)
(s) Cypress Creek, La. (r)
(t) Bayou Zourie, La. (r)
(u) Bayou Castor, La. (r)
(v) Bayou Liberty, La. (u)
(w) Prairie Creek, La. (r)
(x) Pocoson Creek, La. (r)
(y) Williams Creek, La. (h)
(z) Damrell Creek, La. (h)
(aa) Tenmile Creek, La. (h)
(bb) Pearl Creek, La. (h)
(cc) Taureau Bayou, La. (h)
(dd) Selfs Bayou, La. (cc)
(ee) Walker Bayou, La. (cc)
(ff) Bayou Sally, La. (cc)
(gg) Black Haw Creek, La. (h)
(hh) Funks Bayou, La. (h)
(ii) Bayou Lennan, La. (h)
(jj) Bayou San Miguel, La. (h)
(kk) Bayou San Patricio, La. (h)
(ll) Bear Creek, La. (h)
(mm) Cow Creek, La. (h)
(nn) Bayou Clement, La. (h)
(oo) Grand Cane Bayou, La. (h)
(pp) Horse Shoe Bayou, Tex. (h)
(qq) Harris Creek, Tex. (h)
(rr) Delaware Creek, Tex. (h)
(ss) Mill Creek, Tex. (h)
(tt) Little White Oak Creek, Tex. (h)
(uu) Glade Creek, Tex. (h)
(vv) Caney Creek, Tex. (h)
(ww) Rabbit Creek, Tex. (h)
(xx) Winns Creek, Tex. (h)
(yy) Gracies Creek, Tex. (h)
(zz) Morris Creek, Tex. (h)
(aaa) Teneha Creek, Tex. (h)
(bbb) Martinez Creek, Tex. (h)

(ccc) Patroon Creek, Tex. (h)
(ddd) Pologaino Bayou, Tex. (h)
(eee) Housing Bayou, Tex. (h)
(fff) Sugar Creek, Tex. (h)
(ggg) Sandy Creek, Tex. (h)
(hhh) Mill Creek, Tex. (h)
(iii) Little Cow Creek, Tex. (h)
(jjj) Whitman Creek, Tex. (h)
(kkk) Davis Creek, Tex. (h)
(lll) Wilsons Mill Creek, Tex. (h)
(mmm) Cow Creek, Tex. (h)
(nnn) Bayou Deception, Tex. (h)
(ooo) Nichols Creek, Tex. (h)
(ppp) Cypress Creek, Tex. (h)
(qqq) Hoosier Creek, Tex. (ppp)
(rrr) Ballows Bayou, Tex. (h)
(sss) Watts Bayou, Tex. (h)
(ttt) Cypress Bayou, Tex. (h)
(uuu) Adams Bayou, Tex. (h)
(vvv) Cow Bayou, Tex. (h)
(www) Sabine-Neches Canal, Tex. (b) (h) (xxx)
(xxx) Neches River, Tex. (b)
(yyy) Greys Bayou, Tex. (xxx)
(zzz) Star Bayou, Tex. (xxx)
(aaaa) Beards Bayou, Tex. (xxx)
(bbbb) Beards Lake, Tex. (aaaa)
(cccc) Mill Creek, Tex. (xxx)
(dddd) Wright Creek, Tex. (xxx)
(eeee) Angelina River, Tex. (xxx)
(ffff) Molasses Bayou, Tex. (xxx)
(gggg) Brakes Bayou, Tex. (xxx)
(hhhh) Pine Island Bayou, Tex. (xxx)
(iiii) Villiage Creek, Tex. (xxx)
(jjjj) Sabine-Neches Canal, Tex. (xxx) (kkkk)
(kkkk) Port Arthur Canal, Tex. (jjjj) (a)
(llll) Taylors Bayou, Tex. (kkkk)

(Page 718.)

SABINE LAKE. (T-3-a)

CONTRACTS.—1899. Clarke contract was for 67 days, at $119.60 per day.

ENGINEERS (In charge).—The 1904 reference of Capt. Bromwell is **04,** 1914, 1953.

PROJECTS.—Paragraph beginning "Act June 13, 1902." Add reference **04,** 1914.

(Page 719.)

SABINE-NECHES CANAL, ETC. (INCLUDING SABINE RIVER TO ORANGE AND NECHES RIVER TO BEAUMONT, TEX.). (T-3-b)

PRIVATE WORK.—Reference in first paragraph is to **11,** 1817.

JOHNSONS BAYOU, LA. (T-4)

ENGINEERS (In charge).—Col. Adams's report is at **04,** 1912.

PROJECTS.—Footnote reference is H. D. 299, 54th, 2d.

SABINE RIVER, LA. AND TEX. (T-5)

APPROPRIATIONS.—Add. 1895, $4,000 (**95,** 1779—diverted from Sabine Pass).

COMMERCE.—Second paragraph. 407,372 t. is correct.

CONTRACTS.—1880. Add reference **81,** 1322, to Hyatt item.

(Page 720.)

OPERATIONS:

1890–91. Reference is **91,** 1836.

1895–96. Add, Chan. dr. 50′ w. by 8′ deep, from deep water in Sabine R. to deep water in Sabine Lake, **96,** 1514.

SURVEYS.—Second to last paragraph. Substitute Maj. McIndoe for Capt. Wooten.

(Page 721.)

NECHES RIVER, TEX. (T-6)

CONTRACTS.—1881. Add reference **82.** 1425.

ENGINEERS (In charge).—Substitute Maj. J. F. McIndoe, **08,** 483, for Capt. W. P. Wooten. **08,** 474.

OPERATIONS.—1880. Dr. to provide a chan. 5′ x 40′, through bar at mouth of r., Feb.-June, 1880, **80,** 1201.

PROJECTS.—Last paragraph. 8′ is correct, not 6′.

SURVEYS.—Last paragraph. Substitute Maj. McIndoe for Capt. Wooten.

PORT ARTHUR CANAL, TEX. (OPERATING AND CARE). (T-8)

COMMERCE.—Change paragraph to read as follows: "In 1911, 1,880,017 t., mostly petroleum, and its refined products; lumber, sulphur, cotton, and cottonseed products, **12,** 2039. 2040.

(Page 722.)

OPERATIONS:

1911–12. 189,135 c. y. dr. from turning basin. Reference **12.** 2037 is correct.

SABINE PASS HARBOR, TEX. (T-9)

COMMERCE:

Fourth paragraph. Operations by 2 railroads in progress, 1896–97.

Fifth paragraph. The 1899 reference is **99,** 1861.

(Page 723.)

ENGINEERS (In charge).—Capt. Heuer's report for 1883 is **83,** 1047.

OPERATIONS.—1900–1901. Insert after "Sabine" the following: "and 61,538 c. y."

(Page 724.)

PROJECTS.—First paragraph. Reference for 1881 is **81,** 197.

SURVEYS.—Second paragraph. Typographical error. "Of Blue (Blo) Buck Point Pass" is correct.

(Page 725.)

TRINITY RIVER, TEX. (T-10-a)

OPERATIONS:

1879–80. The 1880 reference is **80**, 1288.

1891–92. The 1892 reference is **92**, 1541.

(Page 726.)

TRINITY RIVER, TEX. (T-10-b)

APPROPRIATIONS.—1902 reference is **02**, 337, 1379.

FOOTNOTE.—No. 4 should read "Sur., mouth to Dallas."

(Page 729.)

JEFFERSON, TEX., AND SHREVEPORT, LA. (T-18-a)

TITLE.—Should include reference to Caddo Lake, Red River, and Cypress Bayou. Jefferson is at one end of Caddo Lake, on Cypress Bayou, and Shreveport is on Red R., or at the other end of Caddo Lake. (See map, page 716.)

SURVEYS.—Third paragraph. Substitute for "concurring" the following: "recom. no further work than that contemplated by."

(Page 730.)

CYPRESS BAYOU, LA. AND TEX.

TITLE.—Insert reference to Red River, and to Jefferson, Tex., and Shreveport, La.

ENGINEERS (In charge).—Substitute "Capt. C. L. Potter, **04**, 398" for "Capt. J. F. McIndoe, **04**, 399."

SURVEYS:

Insert as a third paragraph. "Suggestions for imp. called for by joint resolution Feb. 6, 1890; **R.** by Capt. Willard, **90**, 1914."

Second to last paragraph. Substitute for "concurs" the following: "recom. no further work than that contemplated by."

U.—GALVESTON, TEX., DISTRICT.

(Page 747.)

GALVESTON, TEX. (U-30)

TITLE NOTE.—A portion of the work referred to has been constructed since writing that note.

(Page 751.)

SURVEYS.—Paragraph beginning with "Rectangular conditions," change latter word to "coordinates."

X.—VICKSBURG, MISS., DISTRICT.

(Page 787.)

YAZOO RIVER, MISS. (X-4)

ENGINEERS (Assistants).—Add, after Starr's report, "H. M. Marshall. **R.**, **92**, 1631."

(Page 791.)

TALLAHATCHIE RIVER, FROM MOUTH OF COLDWATER RIVER TO BATESVILLE, MISS. (X-10-d)

ENGINEERS (In charge).—Add, Capt. Chas. L. Potter, 1902–03. **R.**, **04**, 2088.

SURVEYS.—Add, Pre. ex., Tallahatchie R., mouth of Coldwater R. to Batesville, au. act June 13, 1902; R. by Capt. Potter (unfav.), **04**, 398, 2088.

(Page 798.)

RED RIVER, LA. AND ARK. (X-28-c)

ENGINEERS (Assistants).—Add, to reports of Marshall, **90**, 1838.

(Page 799.)

RED RIVER, ITS TRIBUTARIES AND OUTLETS, LA., ARK., AND IND T., FULTON TO HEAD OF ATCHAFALAYA. (X-28-d)

CONTRACTS.—1908. O. E. Gammill, constr. Chalk Level Levee, 124,126 c. y., at 10.89¢ c. y. Hall Nattin, constr. Spirit Lake Levee, 50,700 c. y., at 17.74¢ c. y. **09**, 1551.

Y.—LITTLE ROCK, ARK., DISTRICT.

(Page 819.)

ARKANSAS RIVER, ARK., OKLA., AND KANS. (Y-2-b)

APPROPRIATIONS.—Item of 1907 (Pine Bluff, Ark.) has reference **11**, 1883, instead of **12**, 1883.

(Page 821.)

ARKANSAS RIVER. (Y-2-e)

OPERATIONS.—1890-91 and 1891-92. Change "Morris Rocks" to "Moores Rocks."

(Page 822.)

ARKANSAS RIVER. (Y-2-f)

ENGINEERS (Boards).—First paragraph. Convened at Little Rock, Ark.

PRIVATE WORK.—First paragraph. St. Louis Southwestern is correct.

(Page 823.)

ARKANSAS RIVER — REMOVING OBSTRUCTIONS. (Y-2-g)

OPERATIONS.—1879-80. 341 miles of river, not 34, is correct.

(Page 826.)

PETIT JEAN RIVER, ARK. (Y-21)

ENGINEERS (Assistants).—M. A. Orlopp is correct.

(Page 832.)

CLARENDON, AND LOWER WHITE RIVER, ARK. (Y-23-h)

ENGINEERS (Chief of).—Typographical error. Should be Chief of Engineers.

(Page 833.)

CACHE RIVER, ARK. (Y-35)

SURVEYS.—The footnote to the third paragraph should be No. 2.

(Page 834.)

BLACK RIVER, ARK. AND MO. (Y-38)

COMMERCE.—Last paragraph. "C. 1900, 120,698 t.; value, $966,961, **00**, 422."

(Page 835.)

CURRENT RIVER, ARK. AND MO. (Y-39)

COMMERCE.—Statistics paragraph has reference **12**, 797.

CONTRACTS.—Last reference is **95**, 2031.

ENGINEERS (In charge).—Maj. Smith's term began with 1911.

(Page 837.)

ST. FRANCIS RIVER, ARK. AND MO. (Y-47-a)

ENGINEERS (Assistants).—J. B. Rohrer is correct.

OPERATIONS.—1888-89. Second line. "Kennett" is correct.

(Page 839.)

LITTLE RIVER, ARK. AND MO. (FROM HORNERSVILLE TO ITS JUNCTION WITH THE ST. FRANCIS.) (Y-52)

TITLE.—Hornersville, not Homersville.

PROJECTS.—See above.

AA.—CHATTANOOGA AND NASHVILLE, TENN., DISTRICT.

(Page 844.)

MAPS.

Clark Cr. Near top. Should be "Clark R."

(Page 847.)

Left-hand side, near middle.—Change "Abram Cove Cr." to "Abrams Cr."

Below Abram Cove Cr.—Change "Tullulah Cr." to "Cheoah R."

Tuckaseegee R.—Unnamed tributary shown is "Oconalufty R."

(Page 850.)

LOCKS AND DAMS.

Some of those named are to be constructed later, and projects for them may be changed.

(Page 853.)

FORKED DEER RIVER, TENN. (AA-6-a)

APPROPRIATIONS.—Item of 1896 (second) has reference 96, 1902, 1903.

(Page 860.)

TENNESSEE RIVER, BELOW CHATTANOOGA. (AA-18-b)

PHYSICAL CHARACTERISTICS.—Fifth paragraph from bottom. "Chattanooga and Kellers" is correct.

(Page 862.)

TENNESSEE RIVER, CHATTANOOGA TO RIVERTON. (AA-18-d)

APPROPRIATIONS.

First table refers to open channel work, and to Muscle Shoals Canal. Items of 1903, 1904, and 1909, are allotments.

Table of Hales Bar items. Item of 1909 is an allotment.

(Page 865.)

TENNESSEE RIVER, ABOVE CHATTANOOGA. (AA-18-e)

APPROPRIATIONS.—Items of 1907 and 1909. These are allotments.

(Page 867.)

TENNESSEE RIVER, TENN. — MUSCLE SHOALS CANAL. OPERATING AND CARE. (AA-18-g)

FOOTNOTE.—No. 1. Add, act of Mar. 3, 1909.

(Page 868.)

OPERATIONS.—1900-1901. Browns Island, not Brown Island, is correct.

(Page 870.)

HIWASSEE RIVER, TENN. (AA-67)

APPROPRIATIONS.—Items 1902, 1905, 1907, 1909, and 1910, are allotments.

(Page 885.)

CUMBERLAND RIVER, TENN. AND KY.; LOCKS AND DAMS; OPERATING AND CARE. (AA-239-e)

APPROPRIATIONS.—Footnote No. 4. Add, act Mar. 3, 1909.

(Page 886.)

CANEY FORK RIVER, TENN. (AA-263)

OPERATIONS.—1887-88. "568 l. f. spur" is correct.

BB.—LOUISVILLE, KY., DISTRICT.

(Page 898.)

WABASH RIVER, ILL. AND IND. (BB-33)

SUMMARY:

Change total of Part a to $762,000.

Change grand total to $902,858.02.

WABASH RIVER, ILL. AND IND. (BB-33-a)

APPROPRIATIONS.—Change total to $762,000.

CC.—CINCINNATI, OHIO, DISTRICT, NO. 1.

(Page 911.)

TRAP, THE.

The reference 950 should be 954.

OHIO RIVER.—GENERAL FACTS. (CC-1-d)

COMMERCE.—Add reference 12, 886.

(Page 912.)

APPROPRIATIONS—SUMMARY. (CC-1-e)

TABLE 2.—Total, 695,722.27.

TABLE 13.—Period should be 1874-1912.

The total also includes funds derived from tolls, rents, etc.

Grand total, $41,696.492.66.

(Page 913.)

TABLE 1.—Reference at bottom of page should refer also to page 2280.

(Page 914.)

TABLE 2.—Change the 1898 and 1899 items to $21,412.08 and $48,762.97, respectively. The total to $695,722.27, in accordance with the foregoing.

(Page 921.)

CONTRACTS:

Fourth line. Routh, not Roth, is correct.

Dr. and R. excavation. Meyers & Kerr, not Keer, is correct.

Removing rocks, snags, and logs. W. F. Richardson is correct.

(Page 922.)

1891. V. P. Collins, towboat hire, $43.44 per day, 91, 2342, is correct.

(Page 924.)

ENGINEERS (In charge).—Maj. Oakes, 10, 711, is correct.

ENGINEERS (Assistants).—G. S. Kinsey is correct. W. M. Hall is correct.

LEGISLATION.—Last paragraph. 04, 711 is correct reference.

OBSTRUCTIONS.—Fourth paragraph. Reference is 12, 2286.

(Page 954.)

OHIO RIVER. CONSTRUCTION OF MOVABLE DAMS NOS. 2 TO 6. (CC-07-b)

CONTRACTS:

1899. Add reference 99, 2356.

1901. The price, second line, Evansville Cont. Co., should be $118,967.50.

OPERATIONS.—1900-1901. Reference is 01, 2662-2665.

EE.—WHEELING, W. VA., DISTRICT.

(Page 984.)

WATERWAY LIST.
Middle Island Cr., W. Va. (EE-188)
Spelling and title as shown, not "Middle Cr."

(Page 985.)

GUYANDOT RIVER, W. VA. (EE-11)
APPROPRIATIONS.—1899 item has reference **99,** 2499.

(Page 986.)

KANAWHA RIVER, W. VA. (EE-63-a)
COMMERCE.—Diagram of tonnage and value of, and app., right reference is **11,** 2164.

(Page 987.)

ENGINEERS (Assistants).—A. M. Scott. Omit **77,** 684, 709. Lt. T. Turtle.—Add **77,** 684.

(Page 988.)

LEGISLATION.—Omit paragraph beginning "Act of Congress (1875)."

OPERATIONS:
1886-87. The 1887 reference is **87,** 1911.

(Page 989.)

1907-8. Guide crib at Lock No. 11 is correct.

PLANS.—Fifth paragraph. Mr. Fisk, not Fish, is correct.

(Page 990.)

SECRETARY OF WAR.—Reference is **80,** 684.

(Page 992.)

JAMES RIVER AND KANAWHA CANAL, VA. AND W. VA. (EE-63-d)
ENGINEERS (Boards).—Last paragraph. Maj. Weitzel reference should be **74,** ii, 121, 124.

ENGINEERS (Assistants):
W. R. Hutton. Omit reference **75,** ii, 633. Add N. H. Hutton. **R., 75,** ii, 633.
E. Lorraine. Right reference is **71,** 626, etc.

ESTIMATES:
Fourth paragraph. Omit reference **74,** ii, 654.
Fifth line. Reference to "Tunnel" is **71,** 627, 649; and Greenbriar and New Rs. has same reference.

(Page 993.)

OHIO RIVER, CONNECTING WITH JAMES RIVER SURVEY. (EE-63-e)
ENGINEERS (Assistants).—N. H. Hutton, not "W. R.," is correct.

(Page 997.)

LITTLE KANAWHA RIVER, W. VA. (EE-157-a)
APPROPRIATIONS.—The 1909 reference is **09,** 1797.

(Page 998.)

ENGINEERS (Assistants).—The 1892 reference of B. F. Thomas is **92,** 2115, 2118.

(Page 999.)

OPERATIONS.—1898-99. The reference is **99,** 2475.

FF.—PITTSBURGH, PA., DISTRICT.

(Page 1003.)

WATERWAY LIST.

NOTE AT HEAD.—Substitute "opposite Steubenville, Ohio," for "vicinity of Wheeling, W. Va."

MONONGAHELA RIVER, PA. AND W. VA. (FF-6)

SUMMARY:

Part b. Add footnote No. 2, "Does not include $4,000 allotted Sept. 25, 1889, Ex., Sur., and Contingencies."

Part e. Add footnote No. 3, "H. D. 421, 57th Cong., 2d, p. 351."

Part h. Change total, to conform with later office records, to $3,727,347.41.

Grand total. Change, in accordance with the above, to $11,773,201.

(Page 1004.)

MONONGAHELA RIVER, PA. AND W. VA. (FF-6-b)

ENGINEERS (Assistants).—The 1876 report of S. Petitdidier is at 76, ii, 54.

(Page 1005.)

PROJECTS.—Bottom of first paragraph, "locks to be 50′ x 200′" is correct.

(Page 1006.)

MONONGAHELA RIVER, PA.; LOCK AND DAM NO. 7; PURCHASE. (FF-6-c)

Add reference 98, 2188.

(Page 1009.)

MONONGAHELA RIVER, PA. AND W. VA.; LOCKS AND DAMS ON; OPERATING AND CARE. (FF-6-h)

APPROPRIATIONS:

Change the 1900 item to $141,558.90; the 1902 item to $191,810.12 (does not include $106.11 received from damages); the 1908 item to $253,518.93 (does not include $182.43 paid for account of Isthmian Canal Commission); the 1909 item to $241,174.91 (includes $9,208.10, ex., rebuilding Lock and Dam No. 1); the 1910 item to $364,663.38 (includes $173,364.81, ex., rebuilding Lock and Dam No. 1); the 1911 item to have this footnote or explanation: "Includes $161,647.83, ex., rebuilding Lock and Dam No. 1"; the 1912 item to have this note: "Includes $57,999.10, ex., rebuilding Lock and Dam No. 1."

Change total, in accordance with the foregoing, to make it $3,723,516.35.

(Page 1010.)

OPERATIONS.—1911-12. Reference is 12, 2299-2304.

(Page 1014.)

PITTSBURGH HARBOR, PA. (FF-19)

1911-12. 169,000 dr. is correct, not 123,447.

(Page 1015.)

ALLEGHENY RIVER, PA. (FF-20-b)

COMMERCE.—Last paragraph. 76, ii, 147-148 is correct.

(Page 1016.)

PLANS.—Second line at head of page. Takes footnote No. 3, as follows: "Movable dam; est., $269,564."

(Page 1018.)

PROJECTS.—Fifth paragraph. Capt. Sibert's est., $178,732.

(Page 1019.)

ALLEGHENY RIVER, PA.; LOCKS AND DAMS ON; OPERATING AND CARE. (FF-20-e)

APPROPRIATIONS:

1903 item. The allotment for Herrs Island Dam was $9,610; expended, $5,233.62.

The 1904 item is an expenditure.

GG.—KANSAS CITY, MO., DISTRICT.

(Pages 1025 to 1037.)

WATERWAYS LIST.
Substitute the following list:

Missouri River and tributaries.

Explanation: The number in parentheses is that of the receiving stream.

MO. AND IOWA.

1 Mississippi R., Mo.
2 Missouri R., Mo. (1)
3 Taylors Branch, Mo. (2)
4 Little Duckett Cr., Mo. (2)
5 Big Duckett Cr., Mo. (2)
6 Femme Osage Cr., Mo. (2)
7 Little Femme Osage Cr., Mo. (6)
8 Callaway Branch, Mo. (6)
9 Bigelow Cr., Mo. (2)
10 Sehrt Cr., Mo. (9)
11 Tuque Cr., Mo. (2)
12 Charrette Cr., Mo. (2)
13 Dry Fork, Mo. (12)
14 Smith Cr., Mo. (2)
15 Lost Cr., Mo. (2)
16 Little Lost Cr., Mo. (15)
17 Massas Cr., Mo. (2)
18 Loutre R., Mo. (2)
19 Bear Cr., Mo. (18)
20 Clear Cr., Mo. (18)
21 Smiths Branch, Mo. (18)
22 Bachelor Cr., Mo. (18)
23 Whetstone Cr., Mo. (18)
24 Prairie Fork, Mo. (18)
25 Martins Branch, Mo. (24)
26 Dry Fork of Loutre R., Mo. (18)
27 Modoc Cr., Mo. (2)
28 Quick Cr., Mo. (27)
29 Little Tavern Cr., Mo. (2)
30 Big Tavern Cr., Mo. (2)
31 Logan Cr., Mo. (2)
32 Auxvasse Cr., Mo. (2)
33 Harrison Branch, Mo. (32)
34 Crow Cr., Mo. (32)
35 Richland Cr., Mo. (34)
36 Stinson Cr., Mo. (34)
37 Ewings Cr., Mo. (2)
38 Middle R., Mo. (2)
39 Craghead Cr., Mo. (38)
40 Little Auxvasse Cr., Mo. (38)
41 Rivaux Cr., Mo. (2)
42 Cedar Cr., Mo. (2)
43 Millers Cr., Mo. (42)
44 Fowler Cr., Mo. (42)
45 Bonne Femme Cr., Mo. (2)
46 Little Bonne Femme Cr., Mo. (2)
47 Roche Perche Cr., Mo. (2)
48 Hinkson Cr., Mo. (47)
49 Grindstone Cr., Mo. (48)
50 Bear Cr., Mo. (47)
51 Silver Cr., Mo. (47)
52 Long Branch, Mo. (51)
53 Lick Cr., Mo. (47)
54 Stocktons Branch, Mo. (47)
55 Callahan Cr., Mo. (47)
56 Terrapin Cr., Mo. (2)
57 Sinking Cr., Mo. (2)
58 Moniteau Cr., Mo. (2)
59 McGill Branch, Mo. (58)
60 Prairie Fork, Mo. (58)
61 Hungry Mother Cr., Mo. (58)
62 Salt Cr., Mo. (2)
63 Bonne Femme Cr., Mo. (2)
64 Salt Fork, Mo. (63)
65 Adams Branch, Mo. (63)
66 Sulphur Cr., Mo. (63)
67 Richland Cr., Mo. (2)
68 Hurricane Cr., Mo. (2)
69 Greggs Cr., Mo. (2)
70 Chariton R., Mo. and Iowa (2)
71 East Fork, Mo. (70)
72 Doxies Cr., Mo. (71)
73 Batts Cr., Mo. (72)
74 Silver Cr., Mo. (71)
75 Sweet Springs Cr., Mo. (71)
76 Sugar Cr., Mo. (71)
77 Dark Cr., Mo. (71)
78 Middle Fork, Mo. (71)
79 Muncas Cr., Mo. (78)
80 Puzzle Cr., Mo. (70)
81 Long Branch, Mo. (70)
82 Brush Cr., Mo. (70)
83 Palmer Cr., Mo. (2)
84 Lake Cr., Mo. (83)
85 Grand R., Mo. and Iowa (2)
86 Brush Cr., Mo. (85)
87 Salt Cr., Mo. (85)
88 Yellow Cr., Mo. (85)
89 Little Yellow Cr., Mo. (88)
90 Elk Cr., Mo. (88)
91 Locust Cr., Mo. and Iowa (85)
92 East Fork, Mo. and Iowa (91)
93 West Fork, Mo. (91)
94 Parsons Cr., Mo. (85)
95 Medicine Cr., Mo. (85)
96 Thomsons Fork, Mo. and Iowa (85)
97 Honey Cr., Mo. (96)
98 Muddy Cr., Mo. (96)
99 Weldon R., Mo. and Iowa (96)
100 Quicksand Cr., Mo. (96)
101 Sugar Cr., Mo. (96)

102 Big Cr., Mo. and Iowa (85)
103 East Fork of Big Cr., Mo. (102)
104 West Fork of Big Cr., Mo. (102)
105 Sampson Cr., Mo. (85)
106 East Fork, Grand R., Mo. and Iowa (85)
107 Middle Fork, Grand R., Mo. and Iowa (85)
108 West Fork, Grand R., Mo. and Iowa (85)
109 Grindstone Cr., Mo. (85)
110 Honey Cr., Mo. (85)
111 Shoal Cr., Mo. (85)
112 Big Cr., Mo. (85)
113 Shootman Cr., Mo. (112)
114 Wakenda Cr., Mo. (2)
115 Little Wakenda Cr., Mo. (114)
116 Turkey Cr., Mo. (114)
117 Burr Oak Cr., Mo. (116)
118 East Fork, Mo. (114)
119 West Fork, Mo. (114)
120 Moss Cr., Mo. (114)
121 Crooked R., Mo. (2)
122 East Fork, Mo. (121)
123 Middle Fork, Mo. (122)
124 Rocky Fork, Mo. (121)
125 West Fork, Mo. (121)
126 Willow Cr., Mo. (2)
127 Cravens Cr., Mo. (2)
128 Fishing R., Mo. (2)
129 Keeney Branch, Mo. (128)
130 East Fork, Mo. (128)
131 Williams Cr., Mo. (128)
132 Clear Cr., Mo. (128)
133 Carroll Cr., Mo. (132)
134 Muddy Cr., Mo. (132)
135 Rush Cr., Mo. (2)
136 Town Branch, Mo. (2)
137 Shoal Cr., Mo. (2)
138 Little Shoal Cr., Mo. (137)
139 Buckeye Cr., Mo. (2)
140 Rock Cr., Mo. (2)
141 Line Cr., Mo. (2)
142 Platte R., Mo. and Iowa (2)
143 Rush Cr., Mo. (142)
144 Brush Cr., Mo. (142)
145 Prairie Cr., Mo. (142)
146 Little Platte R., Mo. (142)
147 Todds Cr., Mo. (146)
148 First Cr., Mo. (146)
149 Wilkerson Branch, Mo. (146)
150 Roberts Branch, Mo. (146)
151 Dicks Branch, Mo. (142)
152 Castle Cr., Mo. (142)
153 Mauldins Cr., Mo. (152)
154 Third Fork, Mo. and Iowa (142)
155 Honey Cr., Mo. and Iowa (142)
156 North Branch, Mo. and Iowa (142)
157 One Hundred and Two R., Mo. and Iowa (142)
158 White Coal Cr., Mo. (157)
159 Jowler Cr., Mo. (142)
160 Bee Cr., Mo. (2)
161 Jordan Branch, Mo. (160)
162 Pedee Cr., Mo. (2)
163 Bear Cr., Mo. (2)
164 Mission Cr., Mo. (2)
165 Sugar Cr., Mo. (2)
166 Mud Lake (outlet), Mo. (2)
167 Lake Contrary (outlet), Mo. (2)
168 Liniment Cr., Mo. (2)
169 Dillon Cr., Mo. (2)
170 Nodaway R., Mo. and Iowa (2)
171 East Nodaway R., Iowa (170)
172 Middle Nodaway R., Iowa (170)
173 West Nodaway R., Iowa (170)
174 Mile Cr., Iowa (170)
175 Little Tarkio Cr., Mo. (2)
176 Square Cr., Mo. (175)
177 Big Tarkio Cr., Mo. (2)
178 East Fork, Mo. and Iowa (177)
179 Middle Fork, Mo. and Iowa (177)
180 West Fork, Mo. and Iowa (177)
181 Nishnabotna R., Mo. and Iowa (2)
182 Rock Cr., Mo. (181)

IOWA, S. DAK., AND MINN.

183 East Nishnabotna R., Iowa (181)
184 Turkey Cr., Iowa (183)
185 Crooked Cr., Iowa (183)
186 Indian Cr., Iowa (183)
187 West Nishnabotna R., Iowa (181)
188 Walnut R., Iowa (187)
189 Silver Cr., Iowa (187)
190 Keg Cr., Iowa (2)
191 Mosquito Cr., Iowa (2)
192 Indian Cr., Iowa (2)
193 Iowa Lake (outlet), Iowa (2)
194 Pigeon Cr., Iowa (2)
195 Boyer R., Iowa (2)
196 Willow R., Iowa (195)
197 Lone Tree Lake (outlet), Iowa (2)
198 Soldier R., Iowa (2)
199 East Soldier Cr., Iowa (198)
200 Little Sioux R., Iowa (2)
201 Maple R., Iowa (200)
202 Mill Cr., Iowa (200)
203 West Fork, Iowa (200)
204 Big Whiskey Cr., Iowa (203)
205 Sand Hill Lake (outlet), Iowa (2)
206 Floyd R., Iowa (2)
207 Deep Cr., Iowa (206)
208 West Branch, Iowa (206)
209 Perry Cr., Iowa (2)
210 Big Sioux R., Iowa and S. Dak. (2)
211 Broken Kettle Cr., Iowa (210)
212 Indian Cr., Iowa (210)
213 Ford Cr., Iowa (210)
214 Rock R., Iowa and Minn. (210)
215 Little Rock R., Iowa and Minn. (214)
216 Champepeion Cr., Minn. (214)
217 Tom Cr., Iowa (214)
218 Mud Cr., Iowa (214)

S. DAK. AND N. DAK.

219 Bachelor Cr., S. Dak. (210)
220 Silver Cr., S. Dak. (210)
221 Beaver Cr., S. Dak. (210)
222 Brule Cr., S. Dak. (210)
223 Vermillion R., S. Dak. (2)
224 Long Cr., S. Dak. (223)
225 East Fork, S. Dak. (223)
226 Little Vermillion R., S. Dak. (225)
227 West Fork, S. Dak. (223)
228 Turkey Ridge Cr., S. Dak. (223)

229 Clay Cr., S. Dak. (223)
230 James, or Dakota, R., S. Dak. and N. Dak. (2)
231 Wolf Cr., S. Dak. (230)
232 Rock Cr., S. Dak. (230)
233 Redstone Cr., S. Dak. (230)
234 Marsh Cr., S. Dak. (230)
235 Pearl Cr., S. Dak. (230)
236 Foster Cr., S. Dak. (230)
237 Mud Cr., S. Dak. (230)
238 Pipestem Cr., N. Dak. (230)
239 Beaver Cr., N. Dak. (230)
240 Cottonwood Cr., N. Dak. (230)
241 Elm R., S. Dak. and N. Dak. (230)
242 Maple R., S. Dak. and N. Dak. (241)
243 Moccasin Cr., S Dak. (230)
244 Snake R., S. Dak. (230)
245 North Fork, S. Dak. (244)
246 South Fork, S. Dak. (244)
247 Turtle R., S. Dak. (230)
248 Cain Cr., S. Dak. (230)
249 Silver Cr., S. Dak. (230)
250 Sand Hill Cr., S. Dak. (249)
251 Firesteel Cr., S. Dak. (230)
252 West Firesteel Cr., S. Dak. (251)
253 Enemy Cr., S. Dak. (230)
254 Twelvemile Cr., S. Dak. (230)
255 Dry Cr., S. Dak. (230)
256 Lone Tree Cr., S. Dak. (230)
257 Beaver Cr., S. Dak. (230)
258 Silver Cr., S. Dak. (2)
259 Emmanuel Cr., S. Dak. (2)
260 Hoyts Cr., S. Dak. (2)
261 Plum Cr., S. Dak. (2)
262 Choteau Cr., S. Dak. (2)
263 Mosquito Cr., S. Dak. (2)
264 Ansons Cr., S. Dak. (2)
265 Spring Cr., S. Dak. (2)
266 Campbell Cr., S. Dak. (2)
267 Guibert Cr., S. Dak. (2)
268 Cedar Cr., S. Dak. (2)
269 Platte Cr., S. Dak. (2)
270 Fivemile Cr., S. Dak. (2)
271 Snake Cr., S. Dak. (2)
272 Le Compte Cr., S. Dak. (2)
273 Elm Cr., S. Dak. (2)
274 Petersons Cr., S. Dak. (2)
275 American Cr., S. Dak. (2)
276 Crow Cr., S. Dak. (2)
277 Smith Cr., S. Dak. (276)
278 Boxelder Cr., S. Dak. (276)
279 Elm, or Wolf, Cr., S. Dak. (2)
280 Campbell Cr., S. Dak. (2)
281 Soldier Cr., S. Dak. (2)
282 Reynolds Cr., S. Dak. (2)
283 Chapelle Cr., S. Dak. (2)
284 Medicine Cr., S. Dak. (2)
285 Hackberry Cr., S. Dak. (2)
286 Okobojo Cr., S. Dak. (2)
287 Bloody Run Cr., S. Dak. (2)
288 Little Cheyenne R., S. Dak. (2)
289 Pole Cr., S. Dak. (2)
290 Stage Cr., S. Dak. (2)
291 Steamboat Cr., S. Dak. (2)
292 Otter Cr., S. Dak. (2)
293 Swan Cr., S. Dak. (2)
294 Blue Blanket Cr., S. Dak. (2)
295 Olson Cr., S. Dak. (2)
296 Hermaphrodite Cr., S. Dak. (2)

N. DAK.

297 Cat Tail Cr., N. Dak. (2)
298 Little Beaver Cr., N. Dak. (2)
299 Beaver Cr., N. Dak. (2)
300 Horse Head Cr., N. Dak. (2)
301 Long Lake Cr., N. Dak. (2)
302 Apple Cr., N. Dak. (2)
303 East Branch, N. Dak. (302)
304 West Branch, N. Dak. (302)
305 Burnt Cr., N. Dak. (2)
306 Painted Woods Cr., N. Dak. (2)
307 Turtle Cr., N. Dak. (306)
308 Spring Cr., N. Dak. (2)
309 Wolf Cr., N. Dak. (2)
310 Snake Cr., N. Dak. (2)
311 Douglas Cr., N. Dak. (2)
312 Rising Water or Pride Cr., N. Dak. (2)
313 Shell Cr., N. Dak. (2)
314 Little Knife R., N. Dak. (2)
315 White Earth R., N. Dak. (2)
316 Beaver Cr., N. Dak. (2)
317 Tobacco Garden Cr., N. Dak. (2)
318 Little Muddy R., N. Dak. (2)
319 Sandy Cr., N. Dak. (318)

MONT. AND N. DAK. AND CANADA.

320 Little Muddy Cr., Mont. and N. Dak. (2)
321 Red Bank Cr., Mont. and N. Dak. (320)
322 Big Muddy R., Mont. and Canada (2)
323 East Fork, Mont. (322)
324 Poplar R., Mont. (2)
325 Quaking Asp Cr., Mont. (324)
326 East Branch, Mont. and Canada (324)
327 West Branch, Mont. and Canada (324)
328 Tulle Cr., Mont. (2)
329 Wolf Cr., Mont. (2)
330 Little Porcupine Cr., Mont. (2)
331 Milk R., Mont. and Canada (2)
332 Porcupine Cr., Mont. (331)
333 Rocky Cr., Mont. and Canada (331)
334 Frenchmans Cr., Mont. and Canada (331)
335 White Cr., Mont. (331)
336 Cottonwood Cr., Mont. and Canada (331)
337 Woody Island Cr., Mont. (331)
338 Assinniboine Cr., Mont. (331)
339 West Fork, Mont. (338)
340 Twelvemile Cr., Mont. (331)
341 Mud Cr., Mont. (340)
342 Black Cr., Mont. (331)
343 Thirtymile Cr., Mont. (331)
344 Noon Cr., Mont. (331)
345 North Fork, Mont. (331)
346 Battle Cr., Mont. and Canada (345)
347 West Fork, Mont. and Canada (331)
348 Red Rock Cr., Mont. (347)
349 Coulee Cr., Mont. (348)
350 Many Berries Cr., Mont. and Canada (331)
351 North Branch, Canada and Mont. (331)
352 South Branch, Canada and Mont. (331)

MONT.

353 Big Sandy Cr., Mont. (331)
354 Sage Cr., Mont. (353)
355 Snake Cr., Mont. (331)

356 Peoples Cr., Mont. (331)
357 White Horse Cr., Mont. (331)
358 Beaver Cr., Mont. (331)
359 Larb Cr., Mont. (331)
300 Antelope Cr., Mont. (331)
361 Willow Cr., Mont. (331)
362 Skunk Cr., Mont. (2)
363 Champaign Cr., Mont. (2)
364 Wolf Cr., Mont. (2)
365 Gibson Cr., Mont. (2)
366 Timber Cr., Mont. (2)
367 Killed Woman Cr., Mont. (2)
368 Fourchett Cr., Mont. (2)
369 Beauchamp Cr., Mont. (2)
370 Kanuck Cr., Mont. (2)
371 Little Rocky Cr., Mont. (2)
372 Warm Spring Cr., Mont. (2)
373 Calf Cr., Mont. (2)
374 Cow Cr., Mont. (2)
375 Birch Cr., Mont. (2)
376 Sage Cr., Mont. (2)
377 Eagle Cr., Mont. (2)
378 Little Sandy Cr., Mont. (2)
379 Twenty-fourmile Cr., Mont. (2)
380 Marias R., Mont. (2)
381 O'Briens Coulee, Mont. (380)
382 Cottonwood Cr., Mont. (380)
383 Willow Cr., Mont. (380)
384 North Fork, Mont. (383)
385 West Fork, Mont. (383)
386 Cut Bank Cr., Mont. (380)
387 Two Medicine Cr., Mont. (380)
388 Birch Cr., Mont. (380)
389 Schultz Cr., Mont. (380)
390 Piser Cr., Mont. (380)
391 Antelope Cr., Mont. (390)
392 Teton R., Mont. (2)
393 Muddy Cr., Mont. (392)
394 Gravel Bottom Cr., Mont. (392)
395 Sun R., Mont. (2)
396 Big Muddy Cr., Mont. (395)
397 North Fork, Mont. (395)
398 Willow Cr., Mont. (395)
399 South Fork, Mont. (395)
400 Little Muddy Cr., Mont. (2)
401 Trout Cr., Mont. (2)
402 Dearborn R., Mont. (2)
403 Dog Cr., Mont. (2)
404 Rock Cr., Mont. (2)
405 Little Prickly Pear Cr., Mont. (2)
406 Wolf Cr., Mont. (405)
407 Beaver Cr., Mont. (2)
408 Warm Spring Cr., Mont. (2)
409 Crow Cr., Mont. (2)
410 Jefferson R., Mont. (2)
411 Boulder R., Mont. (410)
412 Big Hole R., Mont. (410)
413 North Fork, Mont. (412)
414 South Fork, Mont. (412)
415 Wise R., Mont. (412)
416 Beaver Head R., Mont. (410)
417 Rattlesnake Cr., Mont. (416)
418 Grasshopper Cr., Mont. (416)
419 Horse Prairie Cr., Mont. (416)
420 Red Rock Cr., Mont. (416)
421 Blacktail Deer Cr., Mont. (416)
422 Ruby R., Mont. (416)
423 Willow Cr., Mont. (410)

MONT. AND WYO.

424 Madison R., Mont. and Wyo. (2)
425 West Fork, Mont. (424)
426 East Fork, Mont. and Wyo. (424)
427 Firehole R., Wyo. (424)
428 Gardner R., Wyo. (424)
429 Gallatin R., Mont. (2)
430 West Gallatin R., Mont. and Wyo. (429)
431 East Gallatin R., Mont. (429)
432 Sixteenmile Cr., Mont. (2)
433 Sixmile Cr., Mont. (2)
434 Greyson Cr., Mont. (2)
435 Deep Cr., Mont. (2)
436 Duck Cr., Mont. (2)
437 Confederate Cr., Mont. (2)
438 White Gulch Cr., Mont. (2)
439 Snipe Cr., Mont. (2)
440 Cottonwood Cr., Mont. (2)
441 Wegner Cr., Mont. (2)
442 Sheep Cr., Mont. (2)
443 Bird Cr., Mont. (2)
444 Deep R., Mont. (2)
445 Encampment Cr., Mont. (444)
446 Hound Cr., Mont. (444)
447 Sand Coulee Cr., Mont. (2)
448 Box Elder Cr., Mont. (2)
449 Belt Cr., Mont. (2)
450 Otter Cr., Mont. (449)
451 Highwood Cr., Mont. (2)
452 Spring Cr., Mont. (2)
453 Shonkin Cr., Mont. (2)
454 Shallow Cr., Mont. (2)
455 Crow Cr., Mont. (2)
456 Arrow R., Mont. (2)
457 Pine Cr., Mont. (456)
458 Judith R., Mont. (2)
459 Wolf Cr., Mont. (458)
460 Skull Cr., Mont. (458)
461 Wiltons Cr., Mont. (458)
462 Beaver Cr., Mont. (458)
463 Big Trout Cr., Mont. (458)
464 Warm Spring Cr., Mont. (458)
465 Salt Cr., Mont. (458)
466 Dog Cr., Mont. (2)
467 Armells Cr., Mont. (2)
468 Musselshell R., Mont. (2)
469 Crooked Cr., Mont. (468)
470 Dovetail Cr., Mont. (468)
471 Cat Cr., Mont. (468)
472 Blood Cr., Mont. (468)
473 Wood Cr., Mont. (468)
474 Big Box Elder Cr., Mont. (468)
475 Fords Cr., Mont. (474)
476 McDonald Cr., Mont. (474)
477 Yellow Water Cr., Mont. (474)
478 Elk Cr., Mont. (477)
479 Lawrence Cr., Mont. (477)
480 Willow Cr., Mont. (468)
481 South Willow Cr., Mont. (468)
482 Cameron Cr., Mont. (468)
483 Pole Cr., Mont. (482)
484 Womans Pocket Cr., Mont. (468)
485 Elk Cr., Mont. (468)
486 Hapleys Cr., Mont. (468)
487 North Fork, Mont. (468)
488 American Fork, Mont. (468)
489 Fish Cr., Mont. (468)

490 Big Coulee Cr., Mont. (468)
491 Dean Cr., Mont. (468)
492 Goulden Cr., Mont. (468)
493 Half Breed Cr., Mont. (468)
494 Fattig Cr., Mont. (468)
495 Sage Hen Cr., Mont. (468)
496 Lodge Pole Cr., Mont. (468)
497 Squaw Cr., Mont. (2)
498 Rattlesnake Cr., Mont. (2)
499 Quarrel Cr., Mont. (2)
500 Seven Blackfeet Cr., Mont. (2)
501 Stick Lodge Cr., Mont. (2)
502 Paradise Cr., Mont. (2)
503 Flirt Cr., Mont. (2)
504 Little Dry Fork, Mont. (2)
505 Catamount Cr., Mont. (2)
506 Big Dry Cr., Mont. (2)
507 Big Timber Cr., Mont. (506)
508 Cached Cr., Mont. (506)
509 Crow Rock Cr., Mont. (506)
510 Bridge Cr., Mont. (506)
511 East Branch, Mont. (506)
512 Brow Cr., Mont. (511)
513 Ada Cr., Mont. (506)
514 Carter Cr., Mont. (506)
515 Elk R., Mont. (2)
516 Sand Cr., Mont. (2)
517 Elk Prairie Cr., Mont. (2)
518 Antelope Cr., Mont. (2)
519 Red Water Cr., Mont. (2)
520 Charles Cr., Mont. (2)
521 Hardscrabble Cr., Mont. (2)

N. DAK., MONT., AND WYO.

522 Yellowstone R., N. Dak., Mont., and Wyo. (2)
523 Fourmile Cr., N. Dak. and Mont. (522)
524 Third Hay Cr., N. Dak. and Mont. (522)
525 Second Hay Cr., N. Dak. and Mont. (522)

MONT.

526 Hay Cr., Mont. (522)
527 Lone Tree Cr., Mont. (522)
528 Fox Cr., Mont. (522)
529 Crain Cr., Mont. (522)
530 Sears Cr., Mont. (522)
531 Dunlap Cr., Mont. (522)
532 White Clay Cr., Mont. (522)
533 Burns Cr., Mont. (522)
534 Thirteenmile Cr., Mont. (522)
535 Morgan Cr., Mont. (522)
536 Lower Sevenmile Cr., Mont. (522)
537 Deer Cr., Mont. (522)
538 Upper Sevenmile Cr., Mont. (522)
539 Clear Cr., Mont. (522)
540 Red Route Cr., Mont. (522)
541 Mayradiers Cr., Mont. (522)
542 Cedar Cr., Mont. (541)
543 Cherry Cr., Mont. (541)
544 Custer Cr., Mont. (522)
545 Muster Cr., Mont. (522)
546 Sunday Cr., Mont. (522)
547 Sand Cr., Mont. (522)
548 Horse Cr., Mont. (522)
549 Little Porcupine Cr., Mont. (522)
550 Short Cr., Mont. (522)
551 Great Porcupine Cr., Mont. (522)
552 Starved to Death Cr., Mont. (522)
553 Froze to Death Cr., Mont. (522)
554 Van Horn or Pease Cr., Mont. (522)
555 Alkali Cr., Mont. (522)
556 Buffalo Cr., Mont. (522)
557 Pompeys Pillar Cr., Mont. (522)
558 Rasor Cr., Mont. (522)
559 Crooked Cr., Mont. (522)
560 Butter Cr., Mont. (522)
561 Canon Cr., Mont. (522)
562 Valley Cr., Mont. (522)
563 Keyser Cr., Mont. (522)
564 Sweet Grass Cr., Mont. (522)
565 Big Timber Cr., Mont. (522)
566 Lamar R., Wyo. (522)

MONT. AND WYO.

567 Buffalo Cr., Wyo. and Mont. (566)
568 Hell Roaring Cr., Wyo. and Mont. (522)
569 Mill Cr., Mont. (522)
570 Boulder Cr., Mont. (522)
571 Upper Deer Cr., Mont. (522)
572 Lower Deer Cr., Mont. (522)
573 Bridge Cr., Mont. (522)
574 Stillwater R., Mont. (522)
575 Big Rosebud R., Mont. (574)
576 Clarks Fork, Mont. and Wyo. (522)
577 Red Lodge Cr., Mont. (576)
578 Pryor Cr., Mont. (522)
579 West Fork, Mont. (578)
580 East Fork, Mont. (578)
581 Big Horn R., Mont. and Wyo. (522)
582 Beauvais Fork, Mont. (581)
583 Shoshone R., Wyo. (581)
584 North Fork, Wyo. (583)
585 South Fork, Wyo. (583)
586 Cottonwood Cr., Wyo. (583)
587 Grey Bull R., Wyo. (581)
588 Gooseberry Cr., Wyo. (581)
589 Mee-ye-ro Cr., Wyo. (581)
590 Owl Cr., Wyo. (581)
591 Muddy Cr., Wyo. (581)
592 Wind R., Wyo. (581)
593 Little Wind R., Wyo. (581)
594 Popo Agie R., Wyo. (581)
595 Beaver Cr., Wyo. (581)
596 Poison Cr., Wyo. (581)
597 Kirby Cr., Wyo. (581)
598 No Water Cr., Wyo. (581)
599 No Wood Cr., Wyo. (581)
600 Shell Cr., Wyo. (581)
601 Salt Cr., Wyo. (581)
602 Crystal Spring Cr., Wyo. (581)
603 Trout Cr., Wyo. (581)
604 No Mouth Cr., Wyo. (581)
605 Soap Cr., Mont. (581)
606 Rotten Grass Cr., Mont. (581)
607 Little Big Horn or Greasy Grass R., Mont. (581)
608 Tullocks Fork, Mont. (581)
609 Sarpy Cr., Mont. (522)
610 Armells Cr., Mont. (522)
611 West Fork, Mont. (610)
612 East Fork, Mont. (610)
613 Rosebud R., Mont. (522)
614 Sweeney Cr., Mont. (522)

615 Graveyard Cr., Mont. (522)
616 Tongue R., Mont. and Wyo. (522)
617 Hanging Woman Cr., Mont. and Wyo. (616)
618 O'Dell Cr., Mont. (616)
619 Otter Cr., Mont. (616)
620 Beaver Cr., Mont. (616)
621 Pumpkin Cr., Mont. (616)
622 Squaw Cr., Mont. (616)
623 Cottonwood Cr., Mont. (522)
624 Powder R., Mont. and Wyo. (522)
625 Mispah R., Mont. (624)
626 Cache Cr., Mont. (624)
627 Bloom Cr., Mont. (624)
628 Spring Cr., Mont. (624)
629 Clear Cr., Wyo. (624)
630 Crazy Woman Fork, Wyo. (624)
631 Ninemile Cr., Wyo. (624)
632 North Fork, Wyo. (624)
633 South Fork, Wyo. (624)
634 Buffalo Cr., Wyo. (633)
635 Salt Cr., Wyo. (624)
636 Pumpkin Cr., Wyo. (624)
637 Wild Horse Cr., Wyo. (624)
638 Buffalo Cr., Mont. and Wyo. (624)
639 Bay Horse Cr., Mont. and Wyo. (624)
640 Little Powder R., Mont. and Wyo. (624)
641 Crow Cr., Mont. (624)
642 Sheep Cr., Mont. (624)
643 O'Fallons Cr., Mont. (522)
644 East Fork, Mont. (643)
645 Cabin Cr., Mont. (522)
646 Cedar Cr., Mont. (522)
647 Glendive Cr., Mont. (522)
648 Box Elder Cr., Mont. (522)

MONT., N. DAK., S. DAK., AND WYO.

649 Smith Cr., Mont. and N. Dak. (522)
650 Shadwell Cr., Mont. and N. Dak. (522)
651 Charbonneau Cr., N. Dak. (522)
652 Pebble Cr., N. Dak. (2)
653 Squaw Cr., N. Dak. (2)
654 Tobacco Cr., N. Dak. (2)
655 Tobacco Garden Cr., N. Dak. (2)
656 Clark Cr., N. Dak. (2)
657 Indian Cr., N. Dak. (2)
658 Little Missouri R., N. Dak., S. Dak., Mont., and Wyo. (2)
659 Beaver Cr., N. Dak, and Mont. (658)
660 Big Box Elder Cr., N. Dak., S. Dak., and Mont. (658)
661 Tie Cr., Mont. (658)
662 Cottonwood Cr., Mont. (658)
663 Willow Cr., Mont. (658)
664 Thompsons Cr., Mont. and Wyo. (658)
665 North Fork, Wyo. (658)
666 Deep Cr., N. Dak. (658)
667 Whitetail Cr., N. Dak. (658)
668 Blacktail Cr., N. Dak. (667)
669 Beicegel Cr., N. Dak. (658)
670 Little Beaver or Pretty Cr., N. Dak. (2)
671 Emmanuel Cr., N. Dak. (2)
672 Knife R., N. Dak. (2)
673 Spring Cr., N. Dak. (672)
674 Crooked Cr., N. Dak. (672)
675 Mandan Lake (outlet), N. Dak. (2)
676 Square Butte Cr., N. Dak. (2)
677 Heart R., N. Dak. (2)
678 Sweet Briar Cr., N. Dak. (677)
679 Curlew Cr., N. Dak. (677)
680 Antelope Cr., N. Dak. (677)
681 Little Heart R., N. Dak. (2)
682 Cannon Ball R., N. Dak. (2)
683 Dogtooth Cr., N. Dak. (682)
684 Louse Cr., N. Dak. (683)
685 North Fork, N. Dak. (682)
686 Thirtymile Cr., N. Dak. (685)
687 South Fork, N. Dak. (682)
688 Willow Cr., N. Dak. (2)
689 Pointer Cr., N. Dak. (2)
690 La Barge Cr., N. Dak. (2)
691 Long Soldier Cr., N. Dak. (2)
692 Fourmile Cr., N. Dak. (2)
693 Black Hawk Cr., N. Dak. (2)

S. DAK. AND WYO.

694 Blackfoot Cr., S. Dak. (2)
695 Eagle Feather Cr., S. Dak. (2)
696 Kunkpapa Cr., S. Dak. (2)
697 Cathead Cr., S. Dak. (2)
698 Rampart Cr., S. Dak. (2)
699 Grand R., S. Dak. (2)
700 North Fork, S. Dak. (699)
701 South Fork, S. Dak. (699)
702 Highbank Cr., S. Dak. (699)
703 Bellsman Cr., S. Dak. (2)
704 Green Timber Cr., S. Dak. (2)
705 Le Compte Cr., S. Dak. (2)
706 Owl or Moreau R., S. Dak. (2)
707 Little Moreau Cr., S. Dak. (706)
708 Red Earth Cr., S. Dak. (706)
709 Thunder Cr., S. Dak. (706)
710 Rabbit Cr., S. Dak. (706)
711 Antelope Cr., S. Dak. (710)
712 North Fork, S. Dak. (706)
713 South Fork S. Dak. (706)
714 Sand Ledge Cr., S. Dak. (706)
715 Flint Rock Cr., S. Dak. (706)
716 Four Bears Cr., S. Dak. (2)
717 Buffaloskin Cr., S. Dak. (2)
718 White Brant Cr., S. Dak. (2)
719 Stove or;Cherry Cr., S. Dak. (2)
720 Pascal Cr., S. Dak. (2)
721 No Heart Cr., S. Dak. (2)
722 McKenzie Cr., S. Dak. (2)
723 Fox Cr., S. Dak. (2)
724 Cheyenne R., S. Dak. (2)
725 Cherry Cr., S. Dak. (724)
726 Sulphur Cr., S. Dak. (725)
727 Owl Feather Cr., S. Dak. (725)
728 Big Timber Cr., S. Dak. (724)

S. DAK. AND WYO.

729 Belle Fourche R., S. Dak. and Wyo. (724)
730 Elm or Eightmile Cr. S. Dak. (729)
731 East Elm Cr., S. Dak. (730)
732 Willow Cr., S. Dak. (729)
733 Indian Cr., S. Dak. (729)
734 Dead Horse Cr., S. Dak. (733)
735 Owl Cr., S. Dak. and Wyo. (729)
736 Crow Cr., S. Dak. and Wyo. (729)
737 Red Water Cr., S. Dak. and Wyo. (729)

738 Spearfish Cr., S. Dak. (737)
739 White Wood Cr., S. Dak. (729)
740 Bear Butte Cr., S. Dak. (729)
741 Warren Cr., S. Dak. (729)
742 South Fork, S. Dak. and Wyo. (724)
743 Elk Cr., S. Dak. (742)
744 Box Elder Cr., S. Dak. (742)
745 Rapid Cr., S. Dak. (742)
746 Spring Cr., S. Dak. (742)
747 Battle Cr., S. Dak. (742)
748 Beaver Cr., S. Dak. and Wyo. (742)
749 Black Thunder Cr., Wyo. (742)
750 Antelope Cr., Wyo. (742)
751 Dry Fork, Wyo. (742)
752 Lance Cr., S. Dak. and Wyo. (742)
753 Sage Cr., S. Dak. and Wyo. (742)
754 Cottonwood Cr., S. Dak. and Wyo. (742)

S. DAK., NEBR., AND WYO.

755 Hat Cr., S. Dak., Nebr., and Wyo. (742)
756 Horse Head Cr., S. Dak. (742)
757 Squaw Cr., S. Dak. (724)
758 Ash Cr., S. Dak. (724)
759 Beaver Cr., S. Dak. (724)
760 Snake Cr., S. Dak. (724)
761 Mission Cr., S. Dak. (2)
762 Chantier Cr., S. Dak. (2)
763 Bad R., S. Dak. (2)
764 Willow Cr., S. Dak. (763)
765 Lance Cr., S. Dak. (763)
766 Plum Cr., S. Dak. (763)
767 Mitchell Cr., S. Dak. (763)
768 Medicine Cr., S. Dak. (763)
769 Grindstone Cr., S. Dak. (763)
770 North Fork, S. Dak. (763)
771 Cottonwood Cr., S. Dak. (763)
772 White Water Cr., S. Dak. (763)
773 White Willow Cr., S. Dak. (763)
774 Indian Cr., S. Dak. (763)
775 Brave Bill Cr., S. Dak. (763)
776 Fort George Cr., S. Dak. (2)
777 Loiselle Cr., S. Dak. (2)
778 Cedar Cr., S. Dak. (2)
779 Dry Cr., S. Dak. (2)
780 Medicine Cr., S. Dak. (2)
781 Fish Cr., S. Dak. (2)
782 Camel Cr., S. Dak. (2)
783 Badger Cr., S. Dak. (2)
784 Laurel or Zephyr Cr., S. Dak. (2)
785 American Crow Cr., S. Dak. (2)
786 White R., S. Dak. and Nebr. (2)
787 Bull Cr., S. Dak. (786)
788 Big Cottonwood Cr., Nebr. (786)
789 White Clay Cr., S. Dak. and Nebr. (786)
790 Wounded Knee Cr., S. Dak. (786)
791 Porcupine Cr., S. Dak. (786)
792 Yellow Medicine Cr., S. Dak. (786)
793 Pumpkin Cr., S. Dak. (786)
794 Corn Cr., S. Dak. (786)
795 Bear in the Lodge Cr., S. Dak. (786)
796 Eagle Nest Cr., S. Dak. (786)
797 Pass Cr., S. Dak. (786)
798 Black Pipe Cr., S. Dak. (786)
799 Bad Land Cr., S. Dak. (786)
800 South Fork, S. Dak. (786)
801 Pine Cr., S. Dak. (800)
802 Cutmeat Cr., S. Dak. (800)
803 Rosebud Cr., S. Dak. (800)
804 Oak Cr., S. Dak. (786)
805 Two Tail Cr., S. Dak. (786)
806 Dog Ear Cr., S. Dak. (786)
807 Bull Cr., S. Dak. (2)
808 Whetstone Cr., S. Dak. (2)
809 Scalp Cr., S. Dak. (2)
810 Garden Cr., S. Dak. (2)
811 Ponca Cr., Nebr. and S. Dak. (2)
812 Niobrara R., Nebr. and Wyo. (2)
813 Keya Paha R., Nebr. and S. Dak. (812)
814 Antelope Cr., S. Dak. (813)
815 Burton Cr., S. Dak. (813)
816 Minnechaduza R., Nebr. and S. Dak. (812)

NEBR.

817 Bear Cr., Nebr. (812)
818 Antelope Cr., Nebr. (812)
819 Rush Cr., Nebr. (812)
820 Pepper Cr., Nebr. (812)
821 Weasel Cr., Nebr. (812)
822 Box Butte Cr., Nebr. (812)
823 Pine Cr., Nebr. (812)
824 Deer Cr., Nebr. (812)
825 Snake R., Nebr. (812)
826 Eureka Cr., Nebr. (825)
827 Gordons Cr., Nebr. (812)
828 Plum Cr., Nebr. (812)
829 Evergreen Cr., Nebr. (828)
830 Long Pine Cr., Nebr. (812)
831 Eagle Cr., Nebr. (812)
832 Verdigris R., Nebr. (812)
833 Bazile Cr., Nebr. (2)
834 Bozzle Cr., Nebr. (833)
835 Beaver Cr., Nebr. (2)
836 Bow Cr., Nebr. (2)
837 West Bow Cr., Nebr. (836)
838 Aowa Cr., Nebr. (2)
839 Omaha Cr., Nebr. (2)
840 Elk Cr., Nebr. (839)
841 Spring Cr., Nebr. (2)
842 Blackbird Cr., Nebr. (2)
843 Fish Cr., Nebr. (2)
844 Ponca Cr., Nebr. (2)
845 Mill Cr., Nebr. (2)
846 Florence Lake (outlet), Nebr. (2)
847 Otoe Cr., Nebr. (2)
848 Papillion R., Nebr. (2)
849 Little Papillion Cr., Nebr. (848)
850 Platte R., Nebr. (2)
851 Elkhorn R., Nebr. (850)
852 Logan Cr., Nebr. (851)
853 Plum Cr., Nebr. (851)
854 North Fork, Nebr. (851)
855 Willow Cr., Nebr. (851)
856 South Fork, Nebr. (851)
857 Cache Cr., Nebr. (851)
858 Cedar Cr., Nebr. (851)
859 Taylor Cr., Nebr. (851)
860 Maple Cr., Nebr. (851)
861 Rawhide Cr., Nebr. (851)
862 Shell Cr., Nebr. (850)
863 Lasker Cr., Nebr. (862)
864 Loup R., Nebr. (850)
865 Beaver Cr., Nebr. (864)
866 Cedar Cr., Nebr. (864)

867 North Loup R., Nebr. (864)
868 Calamus R., Nebr., (867)
869 Middle Loup R., Nebr. (864)
870 Dismal R., Nebr. (869)
871 South Loup R., Nebr. (864)
872 Mud Cr., Nebr. (871)
873 Prairie Cr., Nebr. (850)
874 Wood R., Nebr. (850)
875 Buffalo Cr., Nebr. (850)
876 White Horse Cr., Nebr. (850)

NEBR., WYO., AND COLO.

877 North Platte R., Nebr., Wyo., and Colo. (850)
878 Birdwood Cr., Nebr. (877)
879 White Tail Cr., Nebr. (877)
880 Lonergan Cr., Nebr. (877)
881 White Clay Cr., Nebr. (877)
882 Otter Cr., Nebr. (877)
883 Blue R., Nebr. (877)
884 Willow Cr., Nebr. (877)
885 Spoonhill Cr., Nebr. and Wyo. (877)
886 Rawhide Cr., Wyo. (877)
887 Broom Cr., Wyo. (877)
888 Willow Cr., Wyo. (877)
889 Muddy Cr., Wyo. (888)
890 Casper Cr., Wyo. (877)
891 Poison Spider Cr., Wyo. (877)
892 Sweetwater R., Wyo. (877)
893 Sage Hen Cr., Wyo. (892)
894 Rock Cr., Wyo. (892)
895 Willow Cr., Wyo. (892)
896 Sulphur Cr., Wyo. (892)
897 Muddy Cr., Wyo. (892)
898 Sand Cr., Wyo. (877)
899 Deweese Cr., Wyo. (877)
900 Big Sage Cr., Wyo. (877)
901 Little Sage Cr., Wyo. (900)
902 Jack Cr., Wyo. (877)
903 Spring Cr., Wyo. (877)
904 Cow Cr., Wyo. (877)
905 Grand Encampment Cr., Wyo. and Colo. (877)
906 Beaver Cr., Wyo. and Colo. (877)
907 Big Cr., Wyo. (877)
908 Roaring Fork, Colo. (877)
909 Raspberry Cr., Colo. (908)
910 Grizzly Cr., Colo. (877)
911 Illinois Cr., Colo. (877)
912 Michigan R., Colo. (911)
913 Owl Cr., Colo. (912)
914 East Fork or Canadian R., Colo. (877)
915 Beaver Cr., Wyo. (877)
916 South French Cr., Wyo. (877)
917 French Cr., Wyo. (877)
918 Brush Cr., Wyo. (877)
919 Cedar Cr., Wyo. (877)
920 Pass Cr., Wyo. (877)
921 Medicine Bow R., Wyo. (877)
922 Little Medicine Bow R., Wyo. (921)
923 Sheep Cr., Wyo. (922)
924 Muddy Cr., Wyo. (922)
925 Sage Cr., Wyo. (877)
926 Canon Cr., Wyo. (877)
927 Camp Cr., Wyo. (877)
928 Bates Cr., Wyo. (877)
929 Muddy Cr., Wyo. (877)
930 Deer Cr., Wyo. (877)
931 Box Elder Cr., Wyo. (877)
932 La Prele Cr., Wyo. (877)
933 Wagon Hound Cr., Wyo. (877)
934 La Bonte Cr., Wyo. (877)
935 Indian Cr., Wyo. (877)
936 Elkhorn Cr., Wyo. (877)
937 Horseshoe Cr., Wyo. (877)
938 Laramie R., Wyo. and Colo. (877)
939 North Laramie, Wyo. (938)
940 Little Laramie R., Wyo. (938)
941 Sybylle Cr., Wyo. (938)
942 Chugwater Cr., Wyo. (877)
943 Horse Cr., Nebr. and Wyo. (877)
944 Bear Cr., Wyo. (943)
945 Pumpkin Seed Cr., Nebr. (877)
946 Lawrence Cr., Nebr. (945)
947 Smith Branch, Nebr. (877)
948 Ash Cr., Nebr. (877)
949 South Platte R., Nebr. and Colo. (850)
950 Lodge Pole Cr., Colo., Nebr., and Wyo. (949)
951 Moores Cr., Colo. and Wyo. (949)
952 Lewis Cr., Colo. (949)
953 Horsetail or Clear Cr., Colo. (949)
954 Pawnee Cr., Colo. (949)
955 Wild Cat Cr., Colo. (949)
956 Crow Cr., Colo. and Wyo. (949)

COLO.

957 Cache La Poudre R., Colo. (949)
958 Big Thompson Cr., Colo. (949)
959 St. Vrains Cr., Colo. (949)
960 Dry Cr., Colo. (949)
961 Clear Cr., Colo. (949)
962 Bear Cr., Colo. (949)
963 Deer Cr., Colo. (949)
964 North Fork, Colo. (949)
965 Goose or Lost Park Cr., Colo. (949)
966 Tarryall Cr., Colo. (949)
967 Trout Cr., Colo. (949)
968 Fourmile Cr., Colo. (949)
969 South Fork, Colo. (949)
970 Buffalo Slough, Colo. (949)
971 Threemile Cr., Colo. (949)
972 Douglas Cr., Colo. (949)
973 Trout Cr., Colo. (949)
974 Plum Cr., Colo. (949)
975 Willow Cr., Colo. (949)
976 Cherry Cr., Colo. (949)
977 Coal Cr., Colo. (949)
978 Terrapin or Box Elder Cr., Colo. (949)
979 Kiowa Cr., Colo. (949)
980 Bijou Cr., Colo. (949)
981 Little Badger Cr., Colo. (949)
982 Beaver Cr., Colo. (949)
983 Badger Cr., Colo. (982)

NEBR.

984 Skull Cr., Nebr. (850)
985 Otoe Cr., Nebr. (850)
986 Wahoo Cr., Nebr. (850)
987 Upper Clear Cr., Nebr. (986)
988 Silver Cr., Nebr. (987)
989 Sand Cr., Nebr. (986)
990 Cottonwood Cr., Nebr. (986)
991 Salt Cr., Nebr. (986)

992 Weeping Water Cr., Nebr. (2)
993 Squaw Cr., Nebr. (2)
994 Walnut Cr., Nebr. (2)
995 North Table Cr., Nebr. (2)
996 South Table Cr., Nebr. (2)
997 Fox Cr., Nebr. (996)
998 Fourmile Cr., Nebr. (2)
999 Buck Cr., Nebr. (2)
1000 Honey Cr., Nebr. (2)
1001 Little Nemaha R., Nebr. (2)
1002 North Fork, Nebr. (1001)
1003 Prairie Owl Cr., Nebr. (1001)
1004 Muddy Cr., Nebr. (1001)
1005 South Fork, Nebr. (1001)
1006 Whisky Cr., Nebr. (1001)
1007 Jones Cr., Nebr. (2)
1008 Winnebago Cr., Nebr. (2)

NEBR. AND KANS.

1009 Big Nemaha R., Nebr. and Kans. (2)
1010 Muddy Cr., Nebr. (1000)
1011 North Fork, Nebr. (1000)
1012 Long Branch, Nebr. (1011)
1013 South Fork, Nebr. and Kans. (1009)
1014 Camp Cr., Nebr. (1013)
1015 Noharts Cr., Nebr. and Kans. (1009)
1016 Roys Cr., Nebr. and Kans. (1009)

KANS.

1017 Squaw Cr., Kans. (2)
1018 Cedar Cr., Kans. (2)
1019 Wolf Cr., Kans. (2)
1020 Mosquito Cr., Kans. (2)
1021 Charleston Cr., Kans. (2)
1022 Peters Cr., Kans. (2)
1023 Brush Cr., Kans. (2)
1024 Independence Cr., Kans. (2)
1025 Rock Cr., Kans. (1024)
1026 Deer Cr., Kans. (1024)
1027 Whiskey Cr., Kans. (2)
1028 Walnut Cr., Kans. (2)
1029 Salt Cr., Kans. (2)
1030 Plum Cr., Kans. (1029)
1031 Onemile Cr., Kans. (2)
1032 Corral Cr., Kans. (2)
1033 Threemile Cr., Kans. (2)
1034 Fivemile Cr., Kans. (2)
1035 Sevenmile Cr., Kans. (2)
1036 Ninemile Cr., Kans. (2)
1037 Island Cr., Kans. (2)
1038 Honey Cr., Kans. (1037)
1039 Conner Cr., Kans. (2)
1040 Marshall Cr., Kans. (2)
1041 Jersey Cr., Kans. (2)
1042 Kansas R., Kans. (2)
1043 Muncie Cr., Kans. (1042)
1044 Mill Cr., Kans. (1042)
1045 Little Turkey Cr., Kans. (1042)
1046 Betts Cr., Kans. (1042)
1047 East Mission Cr., Kans. (1042)
1048 West Mission Cr., Kans. (1042)
1049 Spring Cr., Kans. (1042)
1050 Wolf Cr., Kans. (1042)
1051 Little Kaw Cr., Kans. (1042)
1052 Big Stranger Cr., Kans. (1042)
1053 Crooked Cr., Kans. (1052)
1054 Walnut Cr., Kans. (1052)
1055 Fall Cr., Kans. (1052)
1056 Jarbalo Cr., Kans. (1052)
1057 Tonganoxie Cr., Kans. (1052)
1058 Ninemile Cr., Kans. (1052)
1059 Crow Cr., Kans. (1058)
1060 Wild Horse Cr., Kans. (1058)
1061 Mud Cr., Kans. (1042)
1062 Buck Cr., Kans. (1042)
1063 Stone House Cr., Kans. (1042)
1064 Grasshopper Cr., Kans. (1042)
1065 Wild Horse Cr., Kans. (1064)
1066 Big Slongh Cr., Kans. (1064)
1067 Little Slough Cr., Kans. (1064)
1068 Fish Pond Cr., Kans. (1067)
1069 Rock Cr., Kans. (1064)
1070 Brush Cr., Kans. (1064)
1071 Walnut Cr., Kans. (1064)
1072 Coal Cr., Kans. (1064)
1073 Cedar Cr., Kans. (1064)
1074 Craig Cr., Kans. (1073)
1075 Mud Cr., Kans. (1073)
1076 Lock Lane Cr., Kans. (1075)
1077 Wolfley Cr., Kans. (1075)
1078 Spring Cr., Kans. (1064)
1079 Mosquito Cr., Kans. (1078)
1080 Straight Cr., Kans. (1078)
1081 Elk Cr., Kans. (1064)
1082 Cedar Cr., Kans. (1064)
1083 Duck Cr., Kans. (1064)
1084 Rock Cr., Kans. (1064)
1085 Muddy Cr., Kans. (1042)
1086 Little Muddy Cr., Kans. (1042)
1087 Indian Cr., Kans. (1042)
1088 Big Soldier Cr., Kans. (1042)
1089 Halfday Cr., Kans. (1088)
1090 Little Soldier Cr., Kans. (1088)
1091 Walnut Cr., Kans. (1088)
1092 Cross Cr., Kans. (1042)
1093 Salt Cr., Kans. (1092)
1094 Sullivan Cr., Kans. (1092)
1095 Illinois Cr., Kans. (1092)
1096 Little Cross Cr., Kans. (1092)
1097 Meyano Cr., Kans. (1092)
1098 Vermilion R., Kans. (1042)
1099 Straight Cr., Kans. (1098)
1100 Red Vermilion Cr., Kans. (1098)
1101 Rock Cr., Kans. (1098)
1102 Brush Cr., Kans. (1101)

KANS., NEBR., AND COLO.

1103 Big Blue R., Kans. and Nebr. (1042)
1104 Cedar Cr., Kans. (1103)
1105 McIntyre Cr., Kans. (1103)
1106 Carnahan Cr., Kans. (1103)
1107 Bluff Cr., Kans. (1103)
1108 Fourmile Cr., Kans. (1107)
1109 Black Vermilion R., Kans. (1103)
1110 Clear Cr., Kans. (1109)
1111 South Fork, Kans. (1109)
1112 North Fork, Kans. (1109)
1113 Vermilion Cr., Kans. (1109)
1114 Mosquito Cr., Kans. (1103)
1115 Spring Cr., Kans. (1103)
1116 Elk Cr., Kans. (1103)
1117 Horseshoe Cr., Kans. (1103)
1118 Mountain Cr., Kans. (1103)

1119 Raemer Cr., Kans. (1103)
1120 Little Blue R., Kans. and Nebr. (1103)
1121 Sandy Cr., Nebr. (1120)
1122 Big Sandy Cr., Nebr. (1120)
1123 Elk Cr., Nebr. (1120)
1124 Mill Cr., Kans. (1120)
1125 Coon Cr., Kans. (1103)
1126 Camp Cr., Kans. (1125)
1127 Swede Cr., Kans. (1103)
1128 Fancy Cr., Kans. (1103)
1129 Otter Cr., Kans. (1128)
1130 Crooked Cr., Kans. (1128)
1131 Walnut Cr., Kans. (1128)
1132 Mill Cr., Kans. (1103)
1133 Wildcat Cr., Kans. (1042)
1134 Sevenmile Cr., Kans. (1042)
1135 Threemile Cr., Kans. (1042)
1136 Onemile Cr., Kans. (1042)
1137 Republican R., Kans., Nebr., and Colo. (1042)
1138 Fourmile Cr., Kans. (1137)
1139 Moll Cr., Kans. (1137)
1140 Peat Cr., Kans. (1137)
1141 Gar Cr., Kans. (1137)
1142 Scribner Cr., Kans. (1137)
1143 Salt Cr., Kans. (1137)
1144 School Cr., Kans. (1137)
1145 Otter Cr., Kans. (1137)
1146 Blakely Cr., Kans. (1137)
1147 Beaver Cr., Nebr. (1137)
1148 Willow Cr., Nebr. (1137)
1149 Farmers Cr., Nebr. (1137)
1150 Thompsons Cr., Nebr. (1137)
1151 Sassacus Cr., Nebr. (1150)
1152 Lovely Cr., Nebr. (1137)
1153 Center Cr., Nebr. (1137)
1154 Turkey Cr., Nebr. (1137)
1155 Rope Cr., Nebr. (1137)
1156 Flag Cr., Nebr. (1137)
1157 Elk Cr., Nebr. (1137)
1158 Muddy Cr., Nebr. (1137)
1159 Beaver Cr., Nebr., Kans., and Colo. (1137)
1160 Sappa Cr., Nebr. and Kans. (1159)
1161 Prairie Dog Cr., Nebr. and Kans. (1137)
1162 Crystal Cr., Nebr. and Kans. (1137)
1163 Rebecca Cr., Nebr. and Kans. (1137)
1164 Lochiel Cr., Nebr. (1137)
1165 Calumet Cr., Nebr. and Kans. (1137)
1166 Reams Cr., Nebr. and Kans. (1137)
1167 Lohff Cr., Nebr. and Kans. (1137)
1168 White Rock Cr., Kans. (1137)
1169 Beaver Cr., Kans. (1137)
1170 Buffalo Cr., Kans. (1137)
1171 Wolf Cr., Kans. (1137)
1172 Millers Cr., Kans. (1137)
1173 Five Creeks Cr., Kans. (1137)
1174 Smoky Hill R., Kans. and Colo. (1042)

KANS.

1175 Chapmans Cr., Kans. (1174)
1176 Abilene Cr., Kans. (1174)
1177 Solomon R., Kans. (1174)
1178 Sand Cr., Kans. (1177)
1179 Lindsey Cr., Kans. (1177)
1180 Pipe Cr., Kans. (1177)
1181 Fisher Cr., Kans. (1177)
1182 Plum Cr., Kans. (1177)
1183 Brown Cr., Kans. (1177)
1184 Dog Cr., Kans. (1183)
1185 Livingstone Cr., Kans. (1177)
1186 North Fork, Kans. (1177)
1187 Beaver Cr., Kans. (1186)
1188 Cedar Cr., Kans. (1186)
1189 Deer Cr., Kans. (1186)
1190 Big Cr., Kans. (1189)
1191 Ash Cr., Kans. (1177)
1192 Wolf Cr., Kans. (1177)
1193 Bow Cr., Kans. (1177)
1194 South Fork, Kans. (1177)
1195 Slate Cr., Kans. (1177)
1196 Sand Cr., Kans. (1177)
1197 Brush Cr., Kans. (1177)
1198 Skunk Cr., Kans. (1194)
1199 Wild Horse Cr., Kans. (1194)
1200 Lost Cr., Kans. (1194)
1201 Box Elder Cr., Kans. (1194)
1202 Elm Cr., Kans. (1194)
1203 Medicine Cr., Kans. (1194)
1204 Kill Cr., Kans. (1194)
1205 Covert Cr., Kans. (1194)
1206 Indian Cr., Kans. (1194)
1207 Twin Cr., Kans. (1194)
1208 Clay Cr., Kans. (1194)
1209 Walnut Cr., Kans. (1177)
1210 Leban Cr., Kans. (1177)
1211 Fourth Cr., Kans. (1177)
1212 Third Cr., Kans. (1177)
1213 Salt Cr., Kans. (1177)
1214 Rattlesnake Cr., Kans. (1213)
1215 Saline R., Kans. (1174)
1216 Spillman Cr., Kans. (1215)
1217 Wolf Cr., Kans. (1215)
1218 Paradise Cr., Kans. (1215)
1219 Salt Cr., Kans. (1215)
1220 Cedar Cr., Kans. (1215)
1221 Hell Cr., Kans. (1215)
1222 West Twin Cr., Kans. (1215)
1223 East Twin Cr., Kans. (1215)
1224 Bullfoot Cr., Kans. (1215)
1225 Elkhorn Cr., Kans. (1215)
1226 Mulberry Cr., Kans. (1215)
1227 Clear Cr., Kans. (1174)
1228 Spring Cr., Kans. (1174)
1229 Oak Cr., Kans. (1174)
1230 Buffalo Cr., Kans. (1174)
1231 Cow Cr., Kans. (1174)
1232 Fossil Cr., Kans. (1174)
1233 Big Cr., Kans. (1174)
1234 Downer Cr., Kans. (1174)
1235 Hackberry Cr., Kans. (1174)
1236 North Hackberry Cr., Kans. (1235)
1237 South Hackberry Cr., Kans. (1235)
1238 Indian Cr., Kans. (1174)
1239 Plum Cr., Kans. (1174)

KANS. AND COLO.

1240 North Fork of Smoky Hill R., Kans. and Colo. (1174)
1241 Turtle Cr., Kans. (1174)
1242 Pond Cr., Kans. (1174)
1243 Goose Cr., Kans. (1174)
1244 Rose Cr., Kans. (1174)
1245 Ladder Cr., Kans. and Colo. (1174)

KANS.

1246 Twin Butte Cr., Kans. (1245)
1247 Big Timber Cr., Kans. (1174)
1248 Shelter Cr., Kans. (1174)
1249 Langdons Cr., Kans. (1174)
1250 Sellers Cr., Kans. (1174)
1251 Wright Cr., Kans. (1174)
1252 Beaver Cr., Kans. (1174)
1253 Coal Cr., Kans. (1174)
1254 Blood Cr., Kans. (1174)
1255 Wolf Cr., Kans. (1174)
1256 Turkey Cr., Kans. (1174)
1257 Oxide Cr., Kans. (1174)
1258 Mud Cr., Kans. (1174)
1259 Ash Cr., Kans. (1174)
1260 Thompson Cr., Kans. (1174)
1261 Bluff Cr., Kans. (1174)
1262 Sharps Cr., Kans. (1174)
1263 Gypsum Cr., Kans. (1174)
1264 Stag Cr., Kans. (1263)
1265 Harvey Cr., Kans. (1263)
1266 Hobbs Cr., Kans. (1263)
1267 McAllister Cr., Kans. (1263)
1268 Holland Cr., Kans. (1174)
1269 Turkey Cr., Kans. (1174)
1270 Lyons Cr., Kans. (1174)
1271 Cary Cr., Kans. (1270)
1272 West Branch, Kans. (1270)
1273 Coal Cr., Kans. (1270)
1274 Line Cr., Kans. (1270)
1275 Clarks Cr., Kans. (1042)
1276 Davis Cr., Kans. (1275)
1277 Humboldt Cr., Kans. (1275)
1278 McDowell Cr., Kans. (1042)
1279 Deep Cr., Kans. (1042)
1280 Antelope Cr., Kans. (1042)
1281 Wells Cr., Kans. (1042)
1282 Turkey Cr., Kans. (1042)
1283 Mill Cr., Kans. (1042)
1284 Mulberry Cr., Kans. (1283)
1285 Hendricks Cr., Kans. (1283)
1286 West Branch, Kans. (1283)
1287 Middle Branch, Kans. (1283)
1288 East Branch, Kans. (1283)
1289 Kinsley Cr., Kans. (1283)
1290 Snokomo Cr., Kans. (1283)
1291 Post Cr., Kans. (1042)
1292 Vassar Cr., Kans. (1042)
1293 Mission Cr., Kans. (1042)
1294 Shonganunga Cr., Kans. (1042)
1295 Deer Cr., Kans. (1294)
1296 Tecumseh Cr., Kans. (1042)
1297 Martin Cr., Kans. (1042)
1298 Wakarusa Cr., Kans. (1042)
1299 Deer Cr., Kans. (1298)
1300 Rock Cr., Kans. (1298)
1301 Washington Cr., Kans. (1298)
1302 Cole Cr., Kans. (1298)
1303 Spring Cr., Kans. (1298)
1304 Captain Cr., Kans. (1298)
1305 Kill Cr., Kans. (1042)
1306 Cedar Cr., Kans. (1042)
1307 Mill Cr., Kans. (1042)
1308 Clear Cr., Kans. (1307)
1309 Little Cr., Kans. (1307)

MO. AND KANS.

1310 Turkey Cr., Mo. and Kans. (1042)
1311 Big Blue R., Mo. and Kans. (2)
1312 Brush Cr., Mo. and Kans. (1311)
1313 Indian Cr., Mo. and Kans. (1311)
1314 Tomahawk Cr., Kans. (1313)
1315 Coffee Cr., Kans. (1311)
1316 Wolf Cr., Kans. (1311)
1317 Round Grove Cr., Mo. (1311)
1318 Rock Cr., Mo. (2)
1319 Sugar Cr., Mo. (2)
1320 Mill Cr., Mo. (2)
1321 Little Blue R., Mo. (2)
1322 Sleepy Branch, Mo. (2)
1323 Sugar Cr., Mo. (2)
1324 Prairie Cr., Mo. (2)
1325 Sniabar Cr., Mo. (2)
1326 Owl Cr., Mo. (1325)
1327 Little Sniabar Cr., Mo. (2)
1328 Tabo Cr., Mo. (2)
1329 Brush Cr., Mo. (1328)
1330 Little Tabo Cr., Mo. (1328)
1331 Graves Cr., Mo. (2)
1332 Buck Cr., Mo. (2)
1333 Bear Cr., Mo. (2)
1334 Fish Cr., Mo. (2)
1335 Moon Cr., Mo. (2)
1336 Lamine R., Mo. (2)
1337 Blackwater R., Mo. (1336)
1338 Salt Fork of Blackwater R., Mo. (1337)
1339 Camp Cr., Mo. (1338)
1340 Rock Cr., Mo. (1338)
1341 Davis Cr., Mo. (1337)
1342 Postoak Cr., Mo. (1337)
1343 Clear Cr., Mo. (1337)
1344 Heaths Cr., Mo. (1336)
1345 Muddy Cr., Mo. (1336)
1346 Flat Cr., Mo. (1336)
1347 Richland Cr., Mo. (1336)
1348 Thomas Branch, Mo. (2)
1349 Petite Saline Cr., Mo. (2)
1350 Stevens Cr., Mo. (1349)
1351 Clarks Fork, Mo. (1349)
1352 Cave Cr., Mo. (1349)
1353 Wolf Cr., Mo. (1352)
1354 Big Splice Cr., Mo. (2)
1355 Little Splice Cr., Mo. (2)
1356 Factory Cr., Mo. (2)
1357 Moniteau Cr., Mo. (2)
1358 Little Moniteau Cr., Mo. (1357)
1359 String Cr., Mo. (1358)
1360 Rock Cr., Mo. (2)
1361 Meadow Cr., Mo. (2)
1362 Grays Cr., Mo. (2)
1363 Sones Cr., Mo. (2)
1364 Moreau R., Mo. (2)
1365 North Moreau Cr., Mo. (1364)
1366 Straight Fork, Mo. (1365)
1367 Burris Fork, Mo. (1365)
1368 South Moreau Cr., Mo. (1364)
1369 Rising Cr., Mo. (2)
1370 Osage R., Mo. and Kans. (2)
1371 Babruty Cr., Mo. (1370)
1372 Little Tavern Cr., Mo. (1370)
1373 Jim Henry Cr., Mo. (1370)

1374 Saline Cr., Mo. (1370)
1375 Little Saline Cr., Mo. (1374)
1376 Gum Cr., Mo. (1370)
1377 Little Buffalo Cr., Mo. (1370)
1378 Buffalo Cr., Mo. (1370)
1379 Cole Camp Cr., Mo. (1370)
1380 Grand R., Mo. (1370)
1381 Tebo Cr., Mo. (1380)
1382 Big Cr., Mo. (1380)
1383 South Cr., Mo. (1380)
1384 Mormon Cr., Mo. (1380)
1385 Deepwater Cr., Mo. (1380)
1386 Gallinipper Cr., Mo. (1370)
1387 Little Monegaw Cr., Mo. (1370)
1388 Big Monegaw Cr., Mo. (1370)
1389 Miami Cr., Mo. (1370)
1390 Mulberry Cr., Mo. (1370)
1391 Sugar Cr., Kans. (1370)
1392 Middle Cr., Kans. (1370)
1393 Big Sugar Cr., Kans. (1370)
1394 Little Sugar Cr., Mo. (1393)
1395 Mine Cr., Mo. and Kans. (1370)
1396 Little Osage R., Mo. and Kans. (1370)
1397 Muddy Cr., Mo. (1396)
1398 Hogles Cr., Mo. (1396)
1399 Pryors Cr., Mo. (1396)
1400 Marmaton R., Mo. and Kans. (1396)
1401 South Fork of Marmaton R., Kans. (1400)
1402 Dry Wood Cr., Mo. and Kans. (1400)
1403 West Fork of Dry Wood Cr., Mo. and Kans. (1402)

MO.

1404 Peshaw Cr., Mo. (1370)
1405 Sac R., Mo. (1370)
1406 Horse Cr., Mo. (1405)
1407 Turnback Cr., Mo. (1405)
1408 Little Sac Cr., Mo. (1405)
1409 Bear Cr., Mo. (1405)
1410 Brush Cr., Mo. (1405)
1411 Pomme de Terre R., Mo. (1370)
1412 Little Pomme de Terre R., Mo. (1411)
1413 Turkey Cr., Mo. (1370)
1414 Deer Cr., Mo. (1370)
1415 Rainey Cr., Mo. (1370)
1416 Bolinger Cr., Mo. (1370)
1417 Niangua R., Mo. (1370)
1418 Little Niangua R., Mo. (1417)
1419 Linn Cr., Mo. (1370)
1420 Grand Auglaise Cr., Mo. (1370)
1421 Dry Auglaise Cr., Mo. (1420)
1422 Bear Cr., Mo. (1370)
1423 Dog Cr., Mo. (1370)
1424 Coon Cr., Mo. (1370)
1425 Big Tavern Cr., Mo. (1370)
1426 Little Tavern Cr., Mo. (1425)
1427 Sugar Cr., Mo. (1370)
1428 Profis Cr., Mo. (1370)
1429 Maries Cr., Mo. (1370)
1430 Little Maries Cr., Mo. (1429)
1431 Loose Cr., Mo. (2)
1432 Cedar Cr., Mo. (1431)
1433 Deer Cr., Mo. (2)
1434 Greasy Cr., Mo. (2)
1435 Baileys Cr., Mo. (2)
1436 Gasconade R., Mo. (2)
1437 Contrary Cr., Mo. (1436)
1438 Painters Cr., Mo. (1436)
1439 Owens Cr., Mo. (1436)
1440 Swan Cr., Mo. (1436)
1441 Jones Cr., Mo. (1436)
1442 Bear Cr., Mo. (1436)
1443 Osage Fork, Mo. (1436)
1444 Clarks Cr., Mo. (1436).
1445 Whetstone Cr., Mo. (1436)
1446 Beaver Cr., Mo. (1436)
1447 Roubidoux Cr., Mo. (1436)
1448 Piney Cr., Mo. (1436)
1449 Little Piney Cr., Mo. (1436)
1450 Spring Cr., Mo. (1436)
1451 Buck Elk Cr., Mo. (1436)
1452 Large Nixon Cr., Mo. (1436)
1453 Pinoak Cr., Mo. (1436)
1454 Second Cr., Mo. (1436)
1455 First Cr., Mo. (1436)
1456 Coles Cr., Mo. (2)
1457 Frene Cr., Mo. (2)
1458 Little Berger Cr., Mo. (2)
1459 Big Berger Cr., Mo. (2)
1460 Boeuf Cr., Mo. (2)
1461 St. Johns Cr., Mo. (2)
1462 Du Bois Cr., Mo. (2)
1463 Dunn Springs Cr., Mo. (2)
1464 Labadie Cr., Mo. (2)
1465 Fiddle Cr., Mo. (2)
1466 Little Tavern Cr., Mo. (2)
1467 Big Tavern Cr., Mo. (2)
1468 Wild Horse Cr., Mo. (2)
1469 Bon Homme Cr., Mo. (2)
1470 Creve Coeur Cr., Mo. (2)
1471 Cold Water Cr., Mo. (2)

(Page 1037.)

MISSOURI RIVER. (GG-2-a)
Milk R. is also in Canada.

(Page 1038.)

MISSOURI RIVER. (GG-2-b)
Claysville to Isbell Stn. is correct.
Dakota R. is correct.
Isbell Station to Rhineland Landing is correct.

(Page 1039.)

Marias R. is correct. Add reference 1028.
Moreau R., with references 1031, 1037, is correct.
Murrays Bend is correct.
Owl River (Moreau R.), with references 1031, and 1037, is correct.
Rhineland Lndg. (see Isbell Stn.), and with reference 1054, is correct.
Rule Reach is correct.
St. Aubert is correct.
Vermilion is spelled with one l, as shown herewith.

(Page 1040.)

MISSOURI RIVER. (GG-2-c)

APPROPRIATIONS.—Add reference **03,** 405.

COMMERCE.—First line. Change 391,000 to 391,020.

PHYSICAL CHARACTERISTICS.—Add references **12,** 831, 832.

PROJECTS:

Add reference **03,** 405.

(Page 1041.)

Add references, **12,** 844, 847, 848.

SURVEYS.—Add references **95,** 2214, 3958.

(Page 1042.)

MISSOURI RIVER—APPROPRIATIONS. (GG-2-d)

FOOTNOTE 4.—Add reference **12,** 2219.

(Page 1043.)

MISSOURI RIVER. (EXCEPT REMOVING SNAGS). (GG-2-e)

ENGINEERS (Assistants).—H. E. Stevens is correct.

(Page 1044.)

PROJECTS.—Paragraph beginning "Rectification of chan." Add reference **79,** 1078.

(Page 1045.)

MISSOURI RIVER, GENERAL IMPROVEMENT. (GG-2-f)

OPERATIONS:

1905–6. 2 pile dikes, 90′ long, constructed Little Blue Reach, not 90 pile dikes. Murrays Bend is correct.

1909–10. Tenth line from bottom of page. 6,564 l. f. concrete piles cast for dike at Bonton Bend.

1910–11. Revet. by contract at Randolph Bend, not Howard, 30% completed.

(Page 1046.)

1911–12. Paragraph beginning "Kansas City to mouth." Revetment in progress at Wayne City Bend, and at Liberty Bend—not completed.

PRIVATE WORK:

Second paragraph. Atchison, Topeka & Santa Fe Ry. Co. is correct.

Paragraph beginning "Floyd River." 200′, not 210′, dike built.

(Page 1047.)

Paragraph beginning "St. Joseph." Add reference **05,** 1689.

PROJECTS:

Third paragraph. Add reference **05,** 1689.

Sixth paragraph from top. Schulz proj., 1908, Sioux City to Kansas City. Annual maintenance of 6′ depth, $97,500.

(Page 1048.)

ENGINEERS (Assistants). — Add L. L. Wheeler. R., **87,** 2983. Omit this reference from O. B. Wheeler's reports.

MISSOURI RIVER, MOUTH TO SIOUX CITY. (GG-2-h)

CONTRACTS.—Add reference **95,** 3986.

(Page 1049.)

ENGINEERS (Chief of).—Atchison report for 1881 is at **81,** 226.

ENGINEERS (In charge):

Maj. Suter. Brownville. Work abandoned, **82,** 1702. Omit 1883 reference.

Mouth to Sioux City. The 1887 reference is **87,** 2914.

Paragraph beginning "Sur. Arrow Rock, Mo." Omit 1887 references.

ENGINEERS (Assistants):

C. S. Pease. **81,** 1637 is correct, not **80,** 1637.

T. C. Bradley. Reference is **81,** 1607.

(Page 1050.)

OPERATIONS:

1881–82. The 1882 reference on the second line is **82,** 1692.

The Ft. Leavenworth reference is **82,** 1691.

The Sioux City reference is to work 2 miles, not 12, above, not below, city.

(Page 1051.)

1889–90. The reference to Kaw Bend works is **90,** 3443.

1894–95. Revetment repairs at St. Joseph, not dike repairs.

1895–96. Revetment repairs at St. Joseph, not dikes.

(Page 1052.)

PHYSICAL CHARACTERISTICS:

Paragraph beginning with "Napoleon." Add **00,** 2852.

Paragraph beginning "Water-gauge." This reference is to locations, not readings.

Paragraph beginning "Floods and ice damaging works." See each annual report, near beginning. See also **96,** 1869.

Paragraph beginning "Gauge readings." "Gauges" is sufficient

(Page 1053.)

PROJECTS.—Paragraph beginning "Specifications for dikes." Add reference 96, 3851.

SURVEYS:

Paragraph beginning "Bankhead constr." The 1900 reference is 00, 4992.

Paragraph beginning "Divisions: First Reach." Line beginning "Omaha Division." The 1892 reference is to 92 (atlas), 158, 161.

Paragraph beginning "Miscellaneous places." Subparagraph beginning "Bakers, Fontanelle." "Senleurs" is correct. Subparagraph beginning "Claysville." Isbell is correct.

(Page 1054.)

MISSOURI RIVER (REMOVING SNAGS, KANSAS CITY TO MOUTH). (GG-2-i)

CONTRACTS.—1886. J. D. Lawnin, not Lavoisin, is correct.

ENGINEERS (In charge).—Maj. Miller. 85, 1663 is correct.

(Page 1055.)

MISSOURI RIVER, ABOVE SIOUX CITY IOWA. (GG-2-j)

CONTRACTS.—1897. The price for brush, McNamara, Miller & Keefe, and J. C. Hayes, is per cord.

ENGINEERS (Chief of).—The 1901 and 1902 reports are 01, 453; 02, 382.

ENGINEERS (In charge):

Missouri R. Commission. The 1887 reference is 87, 2913.

Maj. J. C. Allen. 89, 1787 is correct.

Capt. C. F. Powell. 91, 2231, 2242, 2244, and 2248 is correct.

LEGAL PROCEEDINGS.—96, 1867 is correct.

OPERATIONS:

1881–82. Above Vermilion is correct.

(Page 1056.)

1885–86. Add reference 86, 2167.

PHYSICAL CHARACTERISTICS.—Paragraph beginning "Discharge measurements, Great Falls." Great Falls to Sioux City is correct.

(Page 1057.)

PROJECTS.—Paragraph beginning "Sioux City." The 1897 reference is 97, 2183.

(Page 1058.)

SURVEYS:

Paragraph beginning "Misc." The 1895 reference is 95, 2219.

Paragraph beginning "Sur. of the Missouri R." This was an ex. and sur. Add reference 92, 1875.

MISSOURI RIVER, ABOVE SIOUX CITY. IOWA. (REMOVING OBSTRUCTIONS.) (GG-2-k)

OPERATIONS:

1897–98. Add reference 98, 1865.

1898–99. Add reference 99, 2229.

(Page 1060.)

JAMES RIVER, N. DAK. AND S. DAK. (GG-301-a)

ENGINEERS (In charge).—Add Capt. Chas. F. Powell. R., 93, 2321.

(Page 1061.)

YELLOWSTONE RIVER, N. DAK., MONT. AND WYO. (GG-626)

SURVEYS.—First paragraph. The 1879 reference is 79, 128 in the first line.

(Page 1062.)

KANSAS RIVER, KANS. (GG-1178)

COMMERCE.—Omit "unimportant" from the first paragraph.

(Page 1063.)

OSAGE RIVER, MO. (GG-1457)

ESTIMATES.—The Simpson estimate, 1875, is $3,000,000.

(Page 1066.)

GASCONADE RIVER, MO. (GG-1517)

SURVEYS.—Reference to the Quinn ex. is 08, 550.

HH.—MISSISSIPPI RIVER.

(Page 1070.)

ABSTRACT LIST.
Change abstract numbers HH-306, and HH-319, a to e, respectively, to read HH-319, and HH-332, a to e, respectively.

(Page 1071.)

Apple R. Omit page reference 1102.
Apple Cr. Add this name, and reference 1102.
Batsons Cut. Spell as shown herewith.
Beaver Dam Rock. Not "Beaver Dam."
Big Muddy R. Page 1116, not 1115, is correct.
Bissells Pt. to Calico Isld. is correct.
Bolivar. Correct spelling is shown herewith.

(Page 1072.)

Brooks Break. Page references are 1139, 1149.
Cairo to Keokuk. Page reference is 1143, not 1142.
Cairo to St. Louis. Add page reference 1185.
Caruthersville. Correct spelling is shown herewith.
Cashs Isld. Correct name shown herewith.
Cassville. Add page reference 1105.
Cincinnati. Omit, and add page reference to "Cincinnati Landing."
Curtis Pt. Add page reference 1193.
Dakota. Only page reference 1122 refers to the State of Dakota, the others referring to Dakota, Minn.

(Page 1073.)

Des Moines to Illinois R. Add page reference 1090.
Dubuque to Prairie du Chien. Page reference is 1126.
Fox Isld. Page reference is 1193, not 1195.
Fox R. Page references are 1105 and 1195.

(Page 1074.)

Glasscox. Not Glasscock.
Grand Cairo to Passes. Change to "Grand Prairie to Passes."
Grand Rapids to Brainerd. Reference 1125 should be 1225.
Hannibal to Lagrange. Page 1196 is correct, not 1169.

(Page 1075.)

Illinois R. to Missouri R. Add reference 1090.
Island 65. 1193. Add.
Keokuk to Cairo. Reference 1143, not 1142, is correct.
La Grange to Hannibal. Page 1196, not 1169, is correct.
Lake Borgne. Omit page 1086.
La Salle. Page 1115 is correct, not 1151.

(Page 1076.)

Lockport, Ill., to St. Louis. Add page 1090.
Matthews Bend. Correct spelling shown herewith.
Minneapolis (St. Anthonys Falls). Page 1070, not 1069, is correct.
Minnehaha Cr. Page 1195, not 1194, is correct.
Mississippi, lower. Add pages 1116 and 1145.
Mississippi, upper. Add pages 1120 and 1122.
Missouri, lower. Omit page 1145.
Missouri R. to Ohio R. Add page 1171.

(Page 1077.)

Nininger Slough. Spelling as shown herewith.
Northeast Pass. Page 1097, not 1027.
North Pass. Page 1097, not 1027.
Octave Pass. Page 1097, not 1027.
Oder, The. Not "The Ode."
Ohio R. to Dickeys Isld. Page 1170 is correct.
Opossum Fork is correct.
Oquawka to Dallas City. Add page 1189.
Passes to Grand Prairie, not to "Grand Cairo."
Peruque Isld. is correct, not "Perugue."

(Page 1078.)

Platin, not Plantin, is correct.
Port Allen, not Port Allerton, is correct.
Pontchartrain. Omit page 1086.
Pontoosuc. Spelling is as shown herewith.
Puckett, not Puckert, Isld.
Red R. Omit pages 1186 and 1105.
Reds Landing. Page 1105. Add.
Reads Landing. Omit page 1105.
Reads Landing to Minneiska. Add page 1191.
Reelfoot Crossing. Omit page 1165.
Reelfoot Levee. Add page 1165.
Rhone, The. Add page 1132.
Rock R. Add page 1105.

Rum R. Add page 1122.
St. Cloud. Add page 1226.
St. Francis Levees. Add page 1067.
St. Francis R. to New Madrid. Page 1086 is correct.
St. Louis. Page 1069, not 1169, is correct.
St. Louis to Cairo, Ill. Add page 1185.

(Page 1079.)

St. Paul to Cassville. Page 1192 is correct.
St. Paul to Illinois R. Add page 1171.
Sandusky. Add page 1204.
Sandy Lake Dam. Page 1121, not 1120, is correct.
Smiths Isld. Page 1192, not 1182.
Steele Bayou, not Steale.
Sterling, not Stirling.
Stop Landing. Page 1165 is correct.
Teepeeota Pt. Page 1209, not 1206.
Tensas Basin. Add page 1147.
Tensas, upper. Add page 1147.

(Page 1080.)

Waupeton. Add pages 1208, 1209.
Whipple Co. Bar, is correct.
Whisky Chute is correct spelling.
Yellow R., The. Add page 1142.

(Page 1081.)

BOARDS:
Worrall, James. Not "Worral."
Raynolds, Lt. Col. Not "Reynolds."
Weitzel, Maj. Not "Weitzell."

(Page 1082.)

Lt. Col. G. McC. Derby is correct.
Berh. Add pages 1260, 1261.

MISSISSIPPI RIVER COMMISSION:
Omit page 1141.
Comstock, Col. President, 1882–84 (add).
Gillespie, Col. G. L., is correct.
Gillmore, Col. President also from 1879–1882.
Rossell, Col. Member, 1906–1912.
West, Chas. H. Omit year 1916.

ENGINEERS IN CHARGE OF DISTRICTS:
Allen, Maj. C. From 1879–1896.
Farquhar, Maj. F. U., is correct.
Hodges, Lt. J. N. Page 1218, not 1208.

(Page 1083.)

Knight, Capt. J. G. D., is correct.
Mackenzie, Maj. A. Omit page 1211.
Macomb, Col. J. N. Add page 1211.
Shunk, Maj. Omit pages 1188, 1197.
Stickney, Maj. A. In charge from 1878–1881.
Townsend, Capt. In charge from 1892–1904.

ASSISTANTS:
Coppee, H. St. L. Add year 1881.
Davenport, R. Page 1224, not 1242.
Durham, C. W., is correct, not "C." only. Page 1186, not 1182.

(Page 1084.)

Geuder, G. W., Not "Gender."
Gillespie, J. L. Add years 1880–1885.
Jenne, D. C. Not "Jeune."
Long, H. C. Not "N. C." Period from 1868–1871
Meigs, M. Page 1186, not 1182, is correct.
Richards, A. L. Period is from 1899–1905.
Shield, E. M. Not "Shields."
Skinner, J. D. Page 1124, not 1123.
Stephens, A. E. Right spelling is "Stevens."
Suter, Capt. C. R. Omit page 1161.
Terry, F. Not "J."
True, C. S. Page 1173, not 1172.

(Page 1085.)

Willey, O. S. Not "O. L."

PHYSICAL CHARACTERISTICS. — Third paragraph, second column. Reference is 12, 3715.

(Page 1086.)

PROJECTS.—Third paragraph. "The lower part of the river, from Head of Passes to Cairo, and levees on right bank to Cape Girardeau, Mo.," is correct.

(Page 1090.)

APPROPRIATIONS:
Table 37. Total is $9,730,000.01.
Table 38. Total is $26,093.40.
Table 42. Period is 1870–1890.
Table 44. Total is $405,812.03.
Total, 42–44, is $2,983,067.03.
Grand total is $148,992,955.71.

(Page 1093.)

Table 21. 1906 item. Reference is 06, 2487.

(Page 1095.)

Footnote 7. Part of an app. of $160,000 is correct.

(Page 1096.)

Table 44. 1907 item. $18,423.65 is correct. Total is $405,812.03.

(Page 1097.)

No. 27. Port Allen, not Allerton.

(Page 1100.)

MAP (THIRD MISSISSIPPI RIVER DISTRICT).
Millikan, not Miliken, is correct.

(Page 1102.)

No. 168. Ames Towhead, not Island.
No. 172. Calico Island, Ill., is correct.
No. 173. Platin Rock is correct.
No. 183. Carolls Island is correct spelling.

(Page 1105.)

No. 304. Trempealeau is correct spelling.

(Page 1106.)

MAP (ST. LOUIS, MO., DISTRICT).
Lower corner. Birds Point, not Bird, is correct.

(Page 1108.)

MAP (ROCK ISLAND, ILL., DISTRICT).
Upper corner. Wacouta is on opposite side of river from that shown.

(Page 1109.)

MAP (ST. PAUL, MINN., DISTRICT).
Mark in Fort Snelling, opposite St. Paul, at mouth of Minnesota R., left bank.

(Page 1116.)

OPERATIONS:
1890–91. 3,389 snags pulled and 20,571 trees cut.
1892–93. 2,946 snags pulled, 8,214 trees cut, 16 drift piles removed.
1893–94. 3,057 snags pulled, 22,861 trees cut, 19 drift piles, and 5 wrecks removed.
1894–95. 3,307 snags pulled, 17,520 trees cut, 22 drift piles, and 3 wrecks removed.
1895–96. 2,979 snags pulled, 19,648 trees cut, 11 drift piles removed, etc.
1896–97. 3,072 snags pulled, 31,014 trees cut, 24 drift piles, and 2 wrecks removed.
1897–98. 4,253 snags pulled, 14,856 trees cut, 32 drift piles, and 3 wrecks removed.
1898–99. 3,300 snags pulled, 30,695 trees cut, boats repaired, and 34 drift piles removed.
1899–00. 4,479 snags pulled, 22,630 trees cut, boats repaired, and 19 drift piles removed.
1900–01. Piles removed were drift piles.
1901–02. Piles removed were drift piles.
1902–03. Piles removed were drift piles.

(Page 1117.)

MISSISSIPPI RIVER, LOWER. OBSTRUCTIONS. (HH-1-j)
OPERATIONS:
1910–11. Add reference 1898.
NOTE TO OPERATIONS.—Reference 11, 1753 should be 10, 1753.
PRIVATE WORK.—Big Muddy R. is correct.
SURVEYS.—Reference 07, 1612 should be 08, 1612.

(Page 1118.)

MISSISSIPPI RIVER GAUGES. (HH-1-k)
PHYSICAL CHARACTERISTICS:
Meter readings should be "meter ratings."
Low-water readings. The 1912 reference is to page 3758.

(Page 1119.)

MISSISSIPPI RIVER. GAUGING NEAR ST. PAUL. (HH-1-l)
OPERATIONS.—1902–03. Gauges reestablished.

MISSISSIPPI RIVER. RESERVOIRS. (HH-1-m)
BOARDS.—Fourth paragraph begins with the second line of the third paragraph.

(Page 1120.)

ENGINEERS (In charge).—Capt. Chittenden. Omit page reference 2343.

(Page 1126.)

MISSISSIPPI RIVER. HEADWATERS, RESERVOIRS. OPERATION, ETC. (HH-1-n)
PHYSICAL CHARACTERISTICS. — Second paragraph, second column. Reference is 06, 1456.

(Page 1138.)

MISSISSIPPI RIVER—CAIRO TO MOUTH. (HH-15-a)
COMMERCE:
First paragraph. 79, 1019, not 1819.

(Page 1139.)

Receipts and shipments at principal ports. Add the following references: **04**, S., 60; **05**, S., 71; **06**, 2514; **07**, 2661;-**08**, 2695; **09**, 2699; **10**, 2974; **11**, 3228; **12**, 3768.

CONTRACTS:

1888. Andrews Bros., Whisky Chute, 28⅛¢ c. y.

1889. Arnold & McDonell. Alabama Dredging & Jetty Co., dr., 12¢ c. y. T. Sullivan, levees, Skipwith.

1891. E. Evins, brush, $1.17½¢; poles, $1.97½¢. T. A. Helgason, levees, 14.45¢ c. y.

1892–93. Prices ranged from 10¢ upward (in first paragraph): add page 3858.

(Page 1140.)

1894–95. Second paragraph. Contracts were for poles, rather than for piles.

1897–98. Price of towboat, last line of column, $27,750.

1898–99. Prices ranged from 8.74¢.

(Page 1141.)

ENGINEERS (Chief of).—New Orleans H., La. 1879 report is **79**, 106.

(Page 1142.)

MISSISSIPPI RIVER COMMISSION:

Reports for 1885, **85**, 2535, 2573.

Col. Rossell, member from 1906–1912.

R. S. Taylor, from 1881.

(Page 1143.)

ENGINEERS IN CHARGE.—Capt. Rossell. Vicksburg H., **91**, 3663 is correct. Bend sur. of 3d dist., **90**, 3288.

SECRETARY'S OFFICE, M. R. C.—Capt. M. M. Patrick, 1898–1901.

(Page 1144.)

FIRST AND SECOND DISTRICTS:

Capt. S. S. Leach. Omit **85**, 2955. Add **85**, 2955; **90**, 3196, 3211.

Capt. S. W. Roessler. Omit **91**, 3586.

THIRD DISTRICT.—Capt. C. B. Sears. The 1886 report is **86**, 2162.

ASSISTANTS:

G. Burney. The 1881 report is **81**, 1382.

(Page 1145.)

T. G. Dabney is correct.

ASSISTANTS, SECRETARY'S OFFICE, M. R. C.:

O. W. Ferguson. **85**, 2650 is correct.

W. Gerig. Report for 1905 is **05**, S., 128.

(Page 1146.)

B. B. Gordon. Osceola Bar, not Oceola.

(Page 1147.)

A. Hider. Plant repairs, **99**, 3544 is correct. Revetment work, **99**, 3544 is correct. Surs., etc., **99**, 3544 is correct.

G. C. Thomas. Discharge observations, **93**, 3674 is correct.

H. S. Douglas. Revetment work, **03**, S., 300.

W. Garvin. New Orleans H., **96**, 3717 is correct.

(Page 1148.)

ASSISTANTS:

B. J. Oliveria. **91**, 3540 is correct.

A. F. Wooley, jr. **00**, 4919 is correct.

W. E. Knobloch is correct spelling.

(Page 1149.)

OPERATIONS:

1884. In second line, **85**, 2751, not 2752, is correct.

1888–89. Line beginning "at Baleshed." Reference **89**, 2700 is correct. Line beginning "Chute."—Sterling, not Stirling, is correct. Third line from bottom. **89**, 2737 is correct.

(Page 1150.)

1890–91. Line beginning "of Helena.", **91**, 3592 is preferred reference. Line beginning "Constr. H.", **91**, 3671 is preferred reference.

1891–92. Line beginning "Lake Providence," Substitute "extended" for "extending." Line beginning "and 783," total yardage, 435,550.

1892–93. Line beginning "Revet. at Greenville H.", 5,835 linear feet added.

(Page 1151.)

1894–95. Second district. Line beginning "protected by." **95**, 3619 is reference preferred.

1895–96. Levees. Line beginning "and 36,615." 35,615 in the foregoing is correct.

(Page 1152.)

1900–01. First district. Reference **01**, S., 10 is preferred. Second district.—54,636 c. y. dr. from Wolf R. Third district.—Reference **01**, S., 13 is preferred. Fourth district.—Add the following: "Dr. Red R., **01**, S., 356."

(Page 1153.)

1902-03. Third district. Line beginning "Providence revet." Add reference **03**, S., 14.
1903-04. Line beginning "wall, lower."—Reference preferred is **04**, S., 203. Levees.—5,564,169 c. y. built by U. S., and 8,607,388 c. y. by local board. Reference preferred is **04**, S., 141, 274.
1904-05. First district.—Reference **05**, S., 11 to be added. Levees.—Add reference **05**, S., 20.
1905-06. First paragraph.—Add references **06**, 2525, 2544. Third district, second line.—"Downstream," not "upstream."

(Page 1154.)

1907-08. Second district. Add reference **08**, 2719.
1908-09. Second district.—Add reference **09**, 2737. Levees.—Add reference **09**, 2659.
1909-10. First district. Add reference **10**, 2923.

(Page 1155.)

1911-12. Third district. Second line.—"downstream" instead of "upstream." Fourth district. Line beginning "l. f. revet."—Add after "paved" the words "at Plaquemine."

PHYSICAL CHARACTERISTICS:

Beds. First line. **82**, 2758 correct reference. Last line of paragraph.—Geology of, **78**, 855 is correct.
Crevasses. Add reference **91**, 3463 to line No. 7, and **91**, 3465.
Delta. Reference **78**, 854, not **79**, 854, is correct.

(Page 1156.)

Discharge. Arkansas City and Wilsons Pt. Add reference **90**, 3277.
Discharge observations. Add reference **91**, 3428, 3429.
Floods. Third line from top of second column. Add reference **85**, 2628.
Gauges. Highest and lowest readings. Add **07**, 2664; **10**, 3001; **11**, 3231.

(Page 1157.)

Outlets. Add reference **81**, 2728.

(Page 1158.)

Shoal. Add reference **88**, 2251.
Slopes (scour found). Reference is **93**, 3557.
Stages. Cairo to Head of Passes, **93**, 3662.
Stone. Add reference **07**, 2706.
Water surface. Add reference **95**, 3748.

PRIVATE WORK.—1891-92. Third line. About 213,484 c. y. used by local and State levee authorities, not merely 83,484 c. y. Add reference **92**, 2896.

(Page 1160.)

PROJECTS:

General—Dike experiments. **00**, 4557, not 3557, is correct. Plant, cost of. Third district.—Add reference **05**, S., 224. Fourth district.—Add reference **04**, S., 286, and **05**, S., 285.

(Page 1161.)

SURVEYS:

Precise levels. Add reference **92**, 2946.
Resurveys (bench marks). **95**, 3748 is correct.
Minor (third district). Add reference **12**, 3905. (First and second districts.) Add reference **08**, 2744.

(Page 1162.)

MAPS:

Crevasse sections. **93**, 3920, not 3970, is correct.
Paragraph beginning "Topographical instrument constr." Reference **96**, 3573 is correct.
Banks (caving). Reference **05**, S., 196 is correct.
Cross sections (scour and fill). Reference **01**, S., 232 is correct.

(Page 1163.)

Abattis dikes. Reference **05**, S., 196 is correct.
Districts (third). Reference **04**, S., 244 is correct. Add **01**, S., 310.
Floods (third district). Reference **94**, 2970 is correct, not 2870.
Hydrographs—
  Carrollton and South Pass. **94**, 2858 is correct reference.
  Cairo to Carrollton. **01**, S., 232.
  Anderson Crossing. Add reference **05**, 150.
  Arkansas City. Add reference **89**, 2596.
  Cherokee Crossing. Reference **01**, S., 232 is correct.
  Corona Crossing. Add reference **05**, S., 150.

(Page 1164.)

  Fleeces Crossing. **01**, S., 232 is correct.
  Foot of Island 30. **01**, S., 232 is correct.
  Graves Bayou Crossing. **03**, S., 68 is correct.
  Hopefield Bend and Memphis H. **91**, 3594 is correct.
  Hathaways Crossings. **02**, S., 90 and **03**, S., 68 are correct.

Hickman Crossing. **01**, S., 232 is correct.
Island 21. **03**, S., 68 and **05**, S., 150 are correct.
Island 20. **03**, S., 68 is correct.
Joe Eckles Crossing. **01**, S., 232 and **05**, S., 150 are correct.
Last Chance Crossing. **03**, S., 68 is correct.
Lower Pt. Pleasant Crossing. **05**, S., 150 is correct.
Luxora Crossing. **01**, S., 232 is correct.
Memphis. **91**, 3594 is correct. Add **01**, S., 266.
Montezuma Crossing. **05**, S., 150 is correct.
New Orleans. **89**, 2740 and **95**, 3956 are correct.
New Madrid. **99**, 3512 is correct.
O'Donnells Crossing. **01**, S., 232 is correct.
Old Town, Ark. **09**, 2754 is correct.
Presidents Isld. Crossing. **05**, S., 150 is correct.
Peters Crossing. **05**, S., 150 is correct.
Peters Lower or Ashley Pt. Crossing. **03**, S., 68 is correct.
Peters Upper Crossing. **03**, S., 68 is correct.
Pt. Pleasant Crossing. **01**, S., 232 is correct.
Polks Crossing. **05**, S., 150 is correct.
Presidents Isld. Bar. **01**, S., 232 is correct.
Random Shot or Pecan Pt. Crossing. **05**, S., 150 is correct.
Reelfoot Crossing. **05**, S., 150 is correct.
Tyler Crossing. **01**, S., 232 is correct.

Levees—
Crevasses, closing. **97**, 3836 is correct.
First and second districts. Add **01**, S., 266.

(Page 1165.)

Paragraph beginning "Pontchartrain." Second to last line. **09**, 2728, 2786, is correct.
Second district. Omit last page reference, i. e., 248.
Tensas (lower) and Homochitto levee districts. Omit **03**, 264 and **10**, 3026.
Tensas (upper). Omit **05**, S., 196.

Revetments—
Lake Providence. Annual report for 1890 should be **00**, 4830, etc.

Surveys. "New Bedford Bend" should be "New Madrid Bend." Right reference is **01**, S., 232.

Velocity observations. Change "Louisiana Bend" to "Lake Providence Bend."

(Page 1170.)

MEMPHIS, TENN. (HH-96)

ENGINEERS (In charge).—Capt. Roessler. **91**, 3586 is preferred.

(Page 1171.)

CAIRO TO FALLS OF ST. ANTHONY, ETC. (HH-127-a)

Note under title.—Meramac is correct spelling, not "Maramec."

(Page 1173.)

ESTIMATES.—Eighth paragraph, second column. "Opposite Cairo, $325,500" is correct.

(Page 1174.)

OPERATIONS.—Between Illinois and Ohio Rs. 1874–75. Reference **75**, 65, 479 is preferred.

PHYSICAL CHARACTERISTICS.—Description of river about Alton, **72**, 361.

(Page 1175.)

PROJECTS.—Line beginning "to 10′ above l. w." Omit reference **75**, 447.

(Page 1177.)

SURVEYS.—Line beginning "Missouri to Ohio." Add reference **75**, 480.

OHIO RIVER TO ILLINOIS RIVER (MISSISSIPPI RIVER). (HH-127-b)

CONTRACTS:
1888. J. J. Hauk, wire, 3.2¢ lb., **88**, 1428.
1891. H. S. Brown, extension dam, not "extensive."

ENGINEERS (In charge).—Miss. R. Com. Add reference **85**, 2538.

(Page 1178.)

ENGINEERS (Assistants):
A. F. Freis. Not "Fries."
W. S. Mitchell. Add references **89**, 1682; **91**, 2095; **93**, 2166.
J. O. Holman. Add reference **92**, 1720–22.
C. D. Lamb. Omit reference **83**, 1232. Add references **91**, 2094–96; **92**, 1723; and **93**, 2165, 2167.
S. S. Van Norman. Add **88**, 1434.

OPERATIONS:
1880–81. Omit reference to plate 17, page 1598.

(Page 1179.)

1884–85. Line beginning "R., **85**, 2856." **85**, 2939 preferred to **85**, 2940. Last line of paragraph. **85**, 2856 preferred to **85**, 2857.

(Page 1180.)

PROJECTS:
Paragraph beginning "Dam completed to." **75**, 477 is correct or preferred reference.
Paragraph beginning "At Cape Girardeau." Reference **81**, 1533 is correct.

MAPS:

At Alton H. Add reference 92, 1714.

Add, From Carrolls Isld. to Foster Isld., 87, 1650.

(Page 1181.)

OHIO RIVER TO MISSOURI RIVER. (HH-127-c)

CONTRACTS:

1899. Reference to R. C. Arnold is 99, 2068.

1910. Reference includes page 1921.

(Page 1182.)

ENGINEERS (Assistants).—J. O. Holman. In second line, contraction works, not "protective," is correct.

(Page 1183.)

OPERATIONS:

1897-98. Line beginning "year at." Chester, Ill., not Chesley Isld., is correct.

1898-99. Reference includes up to page 2068.

1899-00. The 1900 reference includes up to page 2637.

1900-01. Line beginning "falo Isld." Liberty, Mo., not Ill., is correct.

1902-03. Line beginning "and raised to." 24′ to 28′, not 26′ to 30′, is correct.

1904-05. Third line. Hurricane Field, not Bend, is correct.

(Page 1184.)

1907-08. Second line. Substitute "Eliza Towhead" for "Osborne Field."

1910-11. Line beginning "Ft. Chartres." Add "restoration and extension of bank protection at Liberty, Mo." Line beginning "way Board made." Reference 11, 1904-10 preferred.

1911-12. Last line of column. Omit "Ill." Second line, second column. Add reference 12, 2114-19. Third line, second column. Add reference 12, 2121. Last line of paragraph. Reference 12, 2122-23, 2127, preferred.

PHYSICAL CHARACTERISTICS.—Fourth paragraph from bottom of column. Omit reference 00, 2637.

(Page 1188.)

ST. LOUIS HARBOR, MISSISSIPPI RIVER. (HH-188)

OPERATIONS:

1872-75. Add reference 74, 60.

1891-92. Reference 92, 1838 is correct.

(Page 1202.)

DES MOINES RAPIDS, MISSISSIPPI RIVER. (HH-222-a)

CONTRACTS.—1888. W. J. Broatch is correct, not Bwatch.

ENGINEERS (Assistants).—J. P. Frizell is correct.

(Page 1212.)

ROCK ISLAND RAPIDS, MISSISSIPPI RIVER. (HH-245)

ENGINEERS (Boards).—Recom., 1866, not 1886.

ENGINEERS (Assistants):

C. H. Beuck is correct.

C. W. Durham is correct.

(Page 1213.)

PROJECTS.—Last paragraph. Amount app. to 1881, not 1866, is correct.

(Page 1220.)

MINNEAPOLIS TO ST. PAUL, MINN (HH-332-d)

ENGINEERS (In charge).—Capt. Schulz reference is 08, 529.

(Page 1223.)

FALLS OF ST. ANTHONY. (ABOVE.) (HH-335-b)

ENGINEERS (Assistants).—A. E. Stevens is correct.

(Page 1225.)

BRAINERD TO GRAND RAPIDS, MINN. (HH-344-a)

COMMERCE.—Second paragraph. 12, 820 is preferred reference.

II.—ST. LOUIS, MO., DISTRICT.

(Page 1228.)

KIMMSWICK.
Erroneously spelled "Ximmswick" on map.

BIRDS POINT.
Erroneously spelled "Bird Point" on map.

(Page 1229.)

KASKASKIA RIVER, ILL. (II-4)
SURVEYS.—Estimate of 1838 was for improvement.

JJ.—ROCK ISLAND, ILL., DISTRICT.

(Page 1233.)

MAPS.
Wacouta, Minn., should be indicated as on the same side of the river as Red Wing, and below the latter.

KK.—ST. PAUL, MINN., DISTRICT.

(Page 1246.)

MAP.
Ft. Snelling. Insert opposite St. Paul.

(Page 1247.)

WATERWAY LIST.
St. Croix Lake and River, Wis. (KK-47.) Is also in Minn.

(Page 1248.)

Minnesota R., Minn. (KK-137-166.) The waterways which follow this stream, after KK-166, are in the JJ geographical district. See page 1234, beginning with Vermilion R., Minn., or JJ-25.

(Page 1253.)

ST. CROIX LAKE AND RIVER, MINN. AND WIS. (KK-47)
SURVEYS.—Ex. of canal connecting Lake Superior and Mississippi R., via St. Croix R., authorized by act Mar. 3, 1909.

(Page 1255.)

MINNESOTA RIVER, MINN. (KK-137)
PROJECTS.—Third paragraph from bottom. The $2,500 was app. 1902, not 1903, for removal of dam near mouth.

(Page 1256.)

BIG STONE LAKE, AND LAKE TRAVERSE, MINN. AND S. DAK. (KK-153-a)
Reference is to KK-170, under title, page 1258.

(Page 1257.)

RED RIVER OF THE NORTH, MINN. AND DAK. (KK-170-a)

OPERATIONS.—1902-03. 134 obstructions, not snags, removed.

(Page 1261.)

WARROAD HARBOR AND RIVER, MINN. (KK-211)

Footnote No. 2 should be H. D. 92, 56th, 2d

LL.—DULUTH, MINN., DISTRICT.

(Page 1264.)

MAP.

McCargoe's Cove is correct. (Isle Royal.)

Isle Royal is correct.

Siskiwit Bay is correct. (Isle Royal.)

Siskiwit, not Siskiwik, River, is correct (east of Port Wing).

(Page 1265.)

WATERWAY LIST.

Waus-wau-goning (LL-4) is correct.

WAUS-WAU-GONING BAY, MINN. (LL-5)

Spelling as shown herewith is correct.

(Page 1266.)

GRAND MARAIS HARBOR, MINN. (LL-9)

COMMERCE.—The 1898 reference in the second paragraph is 98, 2217.

PHYSICAL CHARACTERISTICS.—Harbor situated 106, not 110, m. ne. from Duluth.

PROJECTS:

Third paragraph. Cost of the Quinn project, $165,475.

Fourth paragraph. The Farquhar project was modified, not "substituted."

(Page 1267.)

GRAND MARAIS, MICH. (LL-9-b) (SHOULD BE LL-58)

Should follow Munising Harbor, Mich., of page 1293.

ENGINEERS (In charge).—Maj. Lockwood reference is 01, 513.

(Page 1268.)

SURVEYS.—The 1903 reference to minor surveys is 03, 1825.

(Page 1270.)

AGATE BAY HARBOR, MINN. (LL-14)

OPERATIONS.—1886-87. Preparations were for breakwater construction.

Insert the following—

TWO HARBORS, MINN. (LL-15)

The same as Agate Bay (LL-16).

(Page 1271.)

DULUTH-SUPERIOR HARBOR, MINN. AND WIS. (LL-18)

SUMMARY.—The total includes $19,467.69 miscellaneous receipts.

(Page 1272.)

SURVEYS.—First paragraph. Omit the 1867 reference.

(Page 1273.)

DULUTH HARBOR, MINN. (LL-18-b)

PROJECTS:

Fifth paragraph. Add reference 81, 2027.

Seventh paragraph. Quinn estimate increased total project cost to $332,540.

(Page 1275.)

SUPERIOR BAY AND ST. LOUIS BAY, WIS. (LL-18-d)

PROJECTS.—First paragraph. Add reference 82, 2104.

MINNESOTA POINT, SUPERIOR BAY, MINN. (LL-18-e)

OPERATIONS.—Add reference 91, 313.

PROJECTS.—Second paragraph. Add reference 91, 313.

(Page 1276.)

ALLOUEZ BAY, WIS. (LL-18-f)
See also LL-23-b, on page 1281.

(Page 1278.)

DULUTH-SUPERIOR HARBOR, MINN. AND WIS. (LL-18-g)

OPERATIONS:
1904-05. The reference to lighting of piers, etc., is 05, 1974.
1910-11. The last 1911 reference is to page 2260.
1911-12. North breakwater head—11,547, not 11,549, tons riprap placed.

(Page 1279.)

PRIVATE WORK.—Fourth paragraph. The 1910 reference is to page 2054, not 2055.

SURVEYS.—Seventh paragraph. The 1907 reference is to 07, 603.

(Page 1281.)

PORT WING HARBOR, WIS. (LL-36)

COMMERCE.—Third paragraph. Add reference 08, 1915.

(Page 1282.)

CORNUCOPIA HARBOR, WIS. (LL-38-b)
This is the same as Siskiwit Bay.

(Page 1290.)

KEWEENAW WATERWAY, MICH. (LL-41-a)

SURVEYS.—Maps. The 1903 reference is 1816

(Page 1293.)

MARQUETTE HARBOR, MICH. (LL-54)

SURVEYS.—Maps. Plans, 1904, and 1910 references. Omit reference 11, 2293.

PRESQUE ISLE POINT, MARQUETTE BAY, MICH. (LL-54-b)
Insert as LL-62, on page 1291.

ENGINEERS (In charge).—Gaillard reference for 1902 is 02, 2039.

MM.—MILWAUKEE, WIS., DISTRICT.

(Page 1318.)

STURGEON BAY CANAL, WIS. (PART b, MM-24)

LEGISLATION.—The first word in the second line should be "land."

NN.—CHICAGO, ILL., DISTRICT.

(Page 1349.)

ILLINOIS RIVER, ILL. (NN-1)

SUMMARY:
Part D total should be $278,356.26.
Grand total should be $2,740,006.26.

(Page 1350.)

ILLINOIS RIVER, ILL. (NN-1-a)

ENGINEERS (Assistants).—Brainard references for 1902 and 1903 are 02, 2116, and 03, 1917.

LEGAL PROCEEDINGS.—Third paragraph. Reference to subject of closing Spring Lake, **10**, 2166.

(Page 1351.)

OBSTRUCTIONS.—Last paragraph. **12**, 1022 is correct.

OPERATIONS:

1875-76. **76**, 83 is correct, not 84.
1903-04. **04**, 2951 is correct.

(Page 1353.)

SURVEYS.—Last paragraph (above Maps). **12**, 1022 is correct.

(Page 1354.)

ILLINOIS RIVER, ILL., LOCKS AND DAMS. (NN-1-d)

APPROPRIATIONS:

1901 item is $10,654.97; omit reference to 1912 report.
1904 item is $10,477.04; omit reference to 1912 report.

(Page 1355.)

Total is $278,356.26.

ENGINEERS (In charge).—Maj. Keller reference is **10**, 2167.

PRIVATE WORK.—Lowering of dam at La Grange not completed; work abandoned.

(Page 1356.)

CHICAGO HARBOR, ILL. (NN-14)

Footnote No. 3.—Add reference **95**, 2695.

(Page 1358.)

OPERATIONS.—1911-12. Reference **12**, 2537 is correct.

PHYSICAL CHARACTERISTICS.—Fourth paragraph. Chan. shoaled to 19′.

(Page 1359.)

SURVEYS.—The 1912 reference to Cong. documents is **12**, 1007.

(Page 1361.)

CHICAGO RIVER, ILL. (NN-15)

PRIVATE WORK.—Fourth paragraph from bottom. 52,000 c. y. is correct, not c. f.

SURVEYS.—The 1912 reference to Cong. docs. is **12**, 1007

(Page 1363.)

CALUMET HARBOR, ILL. (NN-17)

OPERATIONS.—1906-07. All project work completed, **07**, 623. (Omit this from 1905-06.)

(Page 1364.)

SURVEYS.—1912 reference to Cong. docs. is **12**, 1024.

CALUMET RIVER, ILL. AND IND. (NN-18)

ENGINEERS (Chief of).—1912 reference is **12**, 1013, 1024.

(Page 1365.)

PHYSICAL CHARACTERISITCS. — Last paragraph. Fourth line up. Little Calumet, not Lake Calumet, is correct.

PROJECTS.—Third line from bottom of column. Make 1902 reference **02**, 2107, 2108.

(Page 1366.)

SURVEYS.—Last paragraph. Reference to Cong. docs., etc., is **12**, 1014; **13**, 1127.

(Page 1369.)

MICHIGAN CITY HARBOR, IND. (NN-23)

CONTRACTS.—1911. 1912 reference is **12**, 2553.

ENGINEERS (In charge).—Maj. Rees's report takes reference **09**, 1999.

ENGINEERS (Assistants).—Capt. Heap's 1870 report has page reference 107, not 17.

(Page 1370.)

OPERATIONS:

1900-01. Reference is to **01**, 3074.
1902-03. Reference is to **03**, 1932.

(Page 1371.)

PROJECTS.—Third paragraph from end (beginning "Aug. 15, 1908"). Add reference **08**, 2000.

(Page 1372.)

LAKE MICHIGAN TO WABASH RIVER, IND. AND OHIO. (NN-24)

PLANS.—Last paragraph, third line from bottom. 1,062 y. l. is correct, not 2,062.

OO.—GRAND RAPIDS, MICH., DISTRICT.

(Page 1376.)

MAP.

The three "tails" to White Pigeon R. and to St. Joseph R., shown as in Ohio, should be cut off. The St. Joseph rises above the Ohio line, and White Pigeon R. rises near the corner of Indiana.

(Page 1377.)

WATERWAY LIST.

White Pigeon R. is in Mich. and Ind. Omit Ohio. (OO-6.)

(Page 1394.)

GRAND RIVER, MICH. (OO-25)

ENGINEERS (Assistants).—Add, Fred Morley. R., 92, 2378.

SURVEYS.—Fifth paragraph. Sur. below Grand Rapids. Add, H. D. Ex., 197, 52d, 1st.

(Page 1413.)

CHARLEVOIX HARBOR AND ENTRANCE TO PINE LAKE, MICH. (OO-58)

PROJECTS.—Last paragraph. Original project of 1868 extended by act Aug. 2, 1882, to include channel Round Lake to Pine Lake, 83, 292, 1806; proj. depth increased by act June 13, 1902, 03, 519.

(Page 1414.)

PETOSKEY HARBOR, MICH.

PROJECTS.—Insert as third paragraph. Act Aug. 18, 1894, adopted the larger ($170,000) project in place of the smaller ($70,000) project, 94, 353.

PP.—DETROIT, MICH., DISTRICT.

(Page 1452.)

DETROIT RIVER, MICH. (PP-105)

COMMERCE.—Fourth paragraph. The 1911 tonnage was 66,951,000.

(Page 1456.)

ROUGE RIVER, MICH. (PP-110)

PROJECTS.—Last paragraph. Project was modified by act Mar. 2, 1907, to increase depth from mouth to first bridge.

RR.—BUFFALO, N. Y., DISTRICT.

(Page 1494.)

ERIE (PRESQUE ISLE) HARBOR, PA. (RR-5-a)

CONTRACTS:

1890. Hingston & Woods is correct.

(Page 1495.)

1905. Shelton contract was for extending south pier.

(Page 1508.)

BLACK ROCK HARBOR AND CHANNEL, N. Y. (RR-13-e)

CONTRACTS.—1910. Arthur L. Vogel is correct.

ENGINEERS (In charge).—First report of Col. Warren as colonel, 1912.

ENGINEERS (Assistant).—J. C. Quintus is correct.

PROJECTS.—Eleventh line. "Barge," not "large," is correct.

(Page 1509.)

TONAWANDA HARBOR AND NIAGARA RIVER, N. Y. (RR-15-a)

ENGINEERS (In charge):

Col. Adams reference for 1906 is 06, 1939.

Col. Fisk reference for 1909 is 09, 2160.

SS.—LOS ANGELES, CAL., DISTRICT.

(Page 1543.)

COLORADO RIVER, ARIZ., CAL., AND NEV. (SS-1)

COMMERCE.—The printed figures in the second paragraph refer to railroad freight. Commerce "very little," and only about 500 tons out, 04, 3393, 3398.

(Page 1545.)

SAN DIEGO HARBOR, CAL. (SS-11)

CONTRACTS:

1896. Reference to Waterman contract, 97, 3338.

1903. Reference to Babcock contract, 03, 2173.

ESTIMATES.—Fifth paragraph. $23,000 is est. in minority report by Maj. Mendell, and covered only jetties in place of riprap, and is only part of estimate for diversion.

(Page 1546.)

PHYSICAL CHARACTERISTICS. — Second paragraph. Sediment observations is correct, not "current."

NEWPORT HARBOR, CAL. (SS-13)

PLANS.—Est. included dredging, and total for all should be $1,620,000.

(Page 1547.)

WILMINGTON HARBOR, CAL. (SS-20-a)

APPROPRIATIONS.—Reference to 1875 item is 75, 123.

CONTRACTS.—1882. Bid was $2.40, and 50¢ c. y.

(Page 1548.)

ENGINEERS (Chief of).—Add reference 00, 4194.

ENGINEERS (In charge).—00, 4191, 4196, 4199, is correct.

OPERATIONS:

1873–74. 3,200′, not 1,680′, is correct.

1874–75. 2,400 c. y. stone, and 1,375 c. y. gravel (not 4,075 t. st.) deposited.

(Page 1550.)

Insert the following (S–22)

SANTA MONICA BAY, CAL. (SS-22)

This title should be inserted on this page, and a reference made to the earlier items of (SS–20–b).

REDONDO BEACH HARBOR, CAL. (SS-21)

PHYSICAL CHARACTERISTICS.—Add reference 93, 3247.

SURVEYS.—Add reference 93, 3247, 3248.

(Page 1551.)

SANTA BARBARA CHANNEL AND HARBOR, CAL. (SS-25)

The references of the 1875 report are to estuary near Pt. Muger also.

(Page 1552.)

SAN LUIS OBISPO HARBOR, CAL. (SS-28)

PLANS.—Third paragraph. Not exactly a repetition, for it refers more to a smaller plan with an estimate of $284,898.

TT.—SAN FRANCISCO, CAL., DISTRICT No. 1.

(Page 1557.)

SANTA CRUZ BAY, CAL. (TT-11)

This refers to Santa Cruz Harbor, Cal. (See map, p. 1554.)

SURVEYS.—By Lt. Col. J. Biddle, for breakwater; est., $1,470,000, and $1,650,000; (unfav.). H. D. 1084, 61st, 3d.

(Page 1559.)

SAN FRANCISCO HARBOR, CAL. (PART D, TT-15)

Noonday Rock is situated about 25 miles west of entrance to Golden Gate, for which reason it might not be classed properly as a part of the works connected with San Francisco.

The wreck of the "Patrician" was one of the early projects. A number of other wrecks have since been removed in the harbor under the usual wreck-removal operations.

(Page 1570.)

HUMBOLDT HARBOR AND BAY, CAL. (TT-175)

Footnote (2) should be omitted as referring to appropriation of 1911.

Footnote (4) refers also to the balance being used for rebuilding jetties.

(Page 1572.)

CRESCENT CITY, CAL. (TT-206)

ENGINEERS (In charge).—Omit the Capt. Leeds reference.

UU.—SAN FRANCISCO, CAL., DISTRICT No. 3.

(Page 1579.)

SAN JOAQUIN RIVER, CAL. (UU-6)

OPERATIONS:
1900–01. 247,222 c. y. dr.
1906–07. 350,191 c. y. dr.

PRIVATE WORK.—21,142 c. y. dr. from Stockton Chan. in 1882 by City of Stockton, 82, 2536. Dr. under Harris was to 16′ x 600′, 08, 2223.

(Page 1580.)

CALIFORNIA DÉBRIS COMMISSION. (UU-6)

Reference under heading should be to "UU-57" instead of to "UU-59."

The app. of $800,000, opposite Part f, includes $400,000 app. by California, Mar. 1, 1909, and deposited in U. S. Treasury July 1, 1911.

(Page 1581.)

CONTRACTS.—Under 1906, the address on the first line should be "1733."

(Page 1583.)

SAN JOAQUIN VALLEY, CAL. (UU-6)

SURVEYS.—The document referred to in the first line under "Maps" is H. D. 290, 42d, 1st.

(Page 1584.)

MOKELUMNE RIVER, CAL. (UU-45)

ENGINEERS (Chief of Engineers).—Report for 1899 is at page 556.

(Page 1585.)

GEORGIANA SLOUGH, CAL. (UU-53)

ENGINEERS (In charge).—Maj. Heuer's R. for 1895 is at page 3328.

(Page 1586.)

SACRAMENTO AND FEATHER RIVERS, CAL. (UU-55)

CONTRACTS.—1908. Should be "Golden Gate Dredging Co., furnishing dredge, $125 a day, 09, 2201."

ENGINEERS (In charge).—Capt. T. H. Jackson's reports are as follows: 07, 2154; 08, 2232; 09, 2200; 10, 2869.

(Page 1587.)

OPERATIONS (Sacramento and Feather Rivers):

1880-81. Second line should read "from Sacramento to Colusa."

1888-89. Reference is to 89, 2486.

1911-12. 48,480 c. y. dr. (first line), and the reference on second line is to 12, 2776-77.

(Page 1588.)

PHYSICAL CHARACTERISTICS (Sacramento and Feather Rivers).—The correct page of the report of 1893 for "Description of" is 3271.

(Page 1589.)

ENGINEERS (Part b).—Chief of Engineers. Reference for 1901 is to page 608.

VV.—PORTLAND, OREG., DISTRICT NO. 1.

(Page 1593.)

WATERWAY LIST.

Malheur R., Oreg. (VV-88) is correct.

WW.—PORTLAND, OREG., DISTRICT NO. 2.

(Page 1614.)

MAP.

Tualatin R. flows into Columbia R. above Willamette Falls.

The middle fork over "Youngs Riv." is Klaskanine Riv.

Alamicut (Deep) Riv. is just below Grays Riv.

Crooked Riv. is just above Grays Riv.

Skamokawa Riv. enters Columbia Riv., right bank, about "three-quarters of an inch" above Grays Riv.

(Page 1616.)

COLUMBIA RIVER. (WW-2-b)

Bradfords Isld. Add page 1631.

Cascades. Add pages 1631, 1634, 1636.

Celilo Falls. Add page 1633.

Columbia R., lower. Insert page 1620.

Columbia R., upper. Add page 1637.

(Page 1617.)

Dalles, The. Add page 1633.

Eutiat Rapids. Correct spelling is Entiat.

Hell Gate is not the New York Hell Gate.

Linnton, not Linton, is correct.

Methow Rapids. Add page 1639.

Mouth, Columbia R. Add pages 1626, 1627.

Riparia to mouth of Snake R. Add page 1634.

Ross Isld. refers to Ross Isld. Channel.

St. Helen refers to St. Helens.

Second Rapids, page 1637, follows Scappoose Bay.

Snag Isld. Add page 1623.

Tongue Pt. Omit "below."

(Page 1618.)

Willamette Bars is correct.

Willamette Slough. Add page 1621.

COLUMBIA RIVER. (WW-2-c)

No. 40 is St. Helens, Oreg.

No. 56 is Dalles-Celilo Canal, Oreg.

(Page 1619.)

COLUMBIA RIVER. (WW-2-d)

The 1905 item in first table was an allotment.

(Page 1620.)

APPROPRIATIONS.—First table. The 1886 item takes reference 86, 2011.

FOOTNOTE NO. 1.—Foster Cr., not Foster Co., is correct.

APPROPRIATIONS:

Table at head of second column. The 1867 item takes reference 67, 51.

Second table, second column. The 1874 item takes reference 74, 118. The 1876 item relates to Upper Columbia and Snake Rs.

(Page 1621.)

COLUMBIA RIVER, OREG. (WW-2-e)

ENGINEERS (Chief of).—Add 83, 337; 84, 341; 85, 368; 86, 365; 88, 303; 89, 361; 90, 329; 91, 419; 92, 393. The 1903 report is 03, 619.

ENGINEERS (In charge).—Add, Capt. C. F. Powell, 1883–86. R., 83, 2076; 84, 2290; 85, 2408; 86, 2010. Maj. Handbury. Add 88, 2177; 89, 2565; 90, 3064; 91, 3372; 92, 2839.

OPERATIONS.—1910–11. "Linnton" is correct.

(Page 1622.)

COLUMBIA AND LOWER WILLAMETTE RIVERS. (WW-2-f)

ENGINEERS (Chief of).—The reports for 79, 183, 1863, refer to mouth of Columbia R.

ENGINEERS (In charge):

Maj. J. M. Wilson. Omit page 1791 of 1879.

Maj. G. L. Gillespie. Reports for 79, 1853, 1864, refer to mouth of Columbia R.

ENGINEERS (Assistants):

Lt. P. M. Price. 81, 2538 refers to mouth of Columbia R.

R. Warrack, not Warrick, is correct.

OPERATIONS:

1873–74. 13,650 c. y. dr., not 17,300. 17,200 c. y. dr. takes reference 75, ii, 758.

1878–79. (Willamette and Columbia.) 13,815 c. y. dr., Willamette; and 14,210 c. y. dr. Columbia.

1880–81. (Willamette and Columbia.) Add reference 81, 2531.

1882–83. (Last line of column.) 12,821 l. f. of revet. is correct.

(Page 1623.)

The correct reference in the first line is 82, 2005, 2006.

1885–86. Add reference 86, 1939.

1888–89. Add reference 89, 2572.

1900–01. Add reference 01, 3559.

1903–04. Third and fourth lines. "For a width of 200′ to a depth of 6′" is correct. Add reference 04, 3536, 3537.

1911–12. Add reference 12, 2817.

PHYSICAL CHARACTERISTICS. — Lower Willamette. Fifth paragraph. Insert "(See Gauging, p. 1621 of this Index.)."

(Page 1624.)

PLANS.—Lower Columbia. In 1871 Maj. Robert requested authority to examine St. Helens Bar and mouth of Willamette.

PRIVATE WORK.—Third paragraph. The expenditure of $10,000 was probably for sluicing St. Helens Bar, or "one of the bars."

PROJECTS.—Paragraph beginning "At 1885." Amount estimated for completion, $467,000.

(Page 1625.)

COLUMBIA RIVER; MOUTH. (WW-2-g)

ENGINEERS (Chief of).—Add references 75, 124; 76, 115; 78, 137; 79, 182.

(Page 1626.)

ENGINEERS (In charge):

Add, Maj. N. Michler, 1875–76. R., 75, ii, 747; 76, ii, 633.

Add, Maj. J. M. Wilson, 1876–79. R., 76, ii, 651; 77, 1003; 78, 1321; 79, 1791, 1853.

OPERATIONS:

1908–09. Add reference 09, 863.

1910–11. Add reference 11, 1017.

PHYSICAL CHARACTERISTICS:

Fourth paragraph. 81, 2542 refers to Columbia and lower Willamette Rs.

(Page 1627.)

Last paragraph. Improvement has given an increase of about 9′ depth on bar, 12, 1220.

PROJECTS.—Second paragraph. "in 1889 to $525,000" is correct.

COLUMBIA RIVER BELOW TONGUE POINT. (WW-2-h)

ENGINEERS (Chief of).—The 1899 reference is 99, 594; and the 1900 reference is 00, 670.

(Page 1629.)

COLUMBIA RIVER, VANCOUVER, WASH., TO MOUTH OF WILLAMETTE RIVER. (WW-2-j)

PROJECTS:

First paragraph. Add reference **92,** 2867.

Langfitt paragraph. Add reference **05,** 676, 677.

COLUMBIA RIVER, OREG.; CANAL, CASCADES. (WW-2-k)

COMMERCE.—Sixth paragraph. Add reference **81,** 2578.

CONTRACTS.—1889. Price of Carrel contract, $1.35 per c. f.

(Page 1630.)

ENGINEERS (Boards).—First paragraph. Width of lock increased from 50′ to 70′; approved by Secretary of War.

OPERATIONS:

1879–80. The 237 c. y. masonry not laid.

1883–84. Add reference **84,** 2255.

1886–87. 58,035 c. y. rock removed.

1887–88. 138 c. y. stone quarried.

1890–91. 8,711 c. f. is correct. 15,520 c. f. is correct. 1,544 c. y. of stone laid in lock walls.

(Page 1631.)

1891–92. The first two clauses should read "79,210 c. f. dimension granite, basalt, and basalt face stone cut; 2,110 c. y. dimension stone and 604 c. y. rubble quarried."

PROJECTS:

First paragraph. The 2 locks were to be 8′ x 46′ x 250′.

Paragraph beginning "In 1888 iron." Substitute "metal" for "iron."

(Page 1632.)

SURVEYS.—Maps. Reference of **89,** 2550 refers to gauge readings, dump cars, and trestles.

(Page 1633.)

COLUMBIA RIVER AT THREEMILE RAPIDS. (WW-2-n)

ENGINEERS (Chief of).—Add reference **79,** 183.

ENGINEERS (Board of).—Third paragraph. Seventh line should read: "canal on Oregon side from above Celilo Falls to below Fivemile."

(Page 1634.)

OPERATIONS.—1910–11. Fifth line. Omit "over," and change "6,000" to 6,048.

PROJECTS.—Paragraph beginning "By BE., 1889." Add reference **90,** 3041.

(Page 1635.)

COLUMBIA (UPPER) AND SNAKE RIVERS, OREG., WASH., AND IDAHO. (WW-2-o)

ENGINEERS (Assistants):

Randall reference is to **75,** ii, 786.

Habersham reference is to **75,** ii, 787, also.

Schubert reference is **03,** 2247.

OPERATIONS:

(Upper Columbia River.) 1873–74. Reference is **74,** 118.

(Columbia and Snake Rivers.) 1879–80. Homely is correct.

(Page 1636.)

PRIVATE WORK.—Add reference **07,** 760.

PROJECTS.—Paragraph beginning "Act 1902 su.", third line should read: "2d), and $25,000 for imp. above Lewiston, **02,** 545, 2375."

(Page 1637.)

COLUMBIA RIVER AND TRIBUTARIES, ABOVE CELILO FALLS. (WW-2-p)

ENGINEERS (Chief of).—Add reference **05,** 752.

OPERATIONS:

1908–09. 1,180 c. y. bowlders, in last line, is correct.

1909–10. Insert after "Rapids," in second line, the following: "Homly Rapids and Devils Bend Rapids."

(Page 1638.)

COLUMBIA RIVER, UPPER. (WW-2-r)

COMMERCE.—The 1893 reference is **93,** 3384.

PHYSICAL CHARACTERISTICS. — Third paragraph. Add reference **93,** 3383.

SURVEYS.—Maps. Omit references to pages 126–9.

COLUMBIA RIVER, ROCK ISLAND RAPIDS TO FOSTER CREEK RAPIDS, WASH. (WW-2-s)

OPERATIONS.—1896–97. Boom was under construction.

(Page 1639.)

COLUMBIA RIVER, WENATCHEE TO BRIDGEPORT, WASH. (WW-2-t)

OPERATIONS.—1910–12. Entiat is correct spelling.

COLUMBIA RIVER, BRIDGEPORT TO KETTLE FALLS, WASH. (WW-2-u)

PROJECT.—Correct reference is to H. D. 16, 60th, 2d.

(Page 1640.)

YOUNGS AND KLASKUINE RIVERS, OREG. (WW-6-a)

PLANS.—Klaskuine is correct spelling.

SURVEYS.—Reference is 90, 2991.

(Page 1641.)

CLATSKANIE RIVER, OREG. (WW-20)

COMMERCE.—In 1906 it was 10,200 tons.

PRIVATE WORK.—Second paragraph. Low water, not mean low water, is correct.

SCAPPOOSE BAY AND CREEK, OREG. (WW-26)

SURVEYS.—Au. by act June 3, 1896, not 1899.

(Page 1642.)

WILLAMETTE RIVER ABOVE PORTLAND, AND YAMHILL AND LONG TOM RIVERS, OREG. (WW-30-b)

COMMERCE:

In the sixth paragraph, the 1908 reference is 08, 819, 2262.

In the seventh paragraph, the 1908 reference is to 08, 818.

CONTRACTS:

1875. The reference is to 76, ii, 660.

1898. The contractor is "Normile, Fastabend and McGregor."

(Page 1643.)

ENGINEERS (In charge).—Add to Maj. McIndoe's reports 09, 2225.

LEGAL PROCEEDINGS.—Add reference 05, 692.

OPERATIONS:

1852. Wing dam, not wing dams, is probably correct.

1871–72. Add reference 72, 984.

1879–80. Scraping on 5 bars only.

1895–96. Over 2,000 snags, not 1,080, is correct.

1899–00. Over 3,700 snags removed.

(Page 1644.)

1906–07. Careys Bend is correct.

PRIVATE WORKS. — Second paragraph. Willamette Transportation and Locks Co. is correct.

(Page 1645.)

PROJECTS.—Paragraph beginning "BE., 1899." Estimate, $456,000.

SURVEYS.—Paragraph beginning "Pre. ex. au. act June 13, 1902." Add reference 04, 3564.

(Page 1646.)

WILLAMETTE RIVER AT WILLAMETTE FALLS, OREG. (WW-30-d)

PHYSICAL CHARACTERISTICS.—Willamette Falls Canal and Locks Co. is correct.

WILLAMETTE RIVER, OREG. ABOVE OREGON CITY. (WW-30-e)

COMMERCE.—Reference to tonnage in second paragraph is 08, [illegible].

TUALATIN RIVER, OREG. (WW-32)

Spelling is as shown herewith.

(Page 1647.)

YAMHILL RIVER, OREG. (WW-33-a)

PLANS.—First paragraph. Add reference 75, ii, 795.

SURVEYS.—By Maj. Michler in 1874.

(Page 1648.)

OPERATIONS:

1900–01. Add reference 01, 3555.

1907–08. Grouting 1,000 square feet of pavement is correct.

(Page 1649.)

COLUMBIA RIVER, OREG. AND WASH. DREDGING PLANT. (WW-41-a)

PROJECTS.—Includes tender and scows.

LEWIS RIVER, WASH. (WW-44)

COMMERCE.—Small boat, not small boats, makes trips above Woodland to Runyan.

ENGINEERS (In charge).—Maj. W. L. Fisk is correct.

(Page 1650.)

PHYSICAL CHARACTERISTICS. — Second paragraph. East Fork, not South Fork, is correct.

(Page 1651.)

COWLITZ RIVER, WASH. (WW-49)

ENGINEERS (In charge).—Maj. Fisk report for 1899 is 99, 3249.

ENGINEERS (Assistants).—Habersham's report for 1880 takes reference 80, 2832.

OPERATIONS.—1911–12. Jetty, not jetties, repaired at Keegans Bar.

PROJECTS.—Second paragraph. Appropriation combined by act of 1902.

(Page 1652.)

BAKERS AND WILLAPA BAYS, WASH. CANAL.

PLANS.—By Capt. Powell, 1882, is correct.

XX.—SEATTLE, WASH., DISTRICT.

(Page 1656.)

WATERWAY LIST.

Togiak Bay, Alaska (XX-167).
Title as shown herewith is correct.
Manopiknak R., Alaska (XX-186).
Title as shown herewith is correct.

(Page 1657.)

Dagitli R., Alaska (XX-234).
Title as shown herewith is correct.

WILLAPA BAY TO COLUMBIA RIVER, OREG. (XX-2-a)

PLANS.—Second paragraph. Canal 24,554′ long is correct.

WILLAPA RIVER AND HARBOR, WASH. (XX-9)

COMMERCE.—In 1911, 771 SS. and 30 sailing vessels entered harbor.

CONTRACTS.—1895. Dickinson contract, piles were 8½¢ l. f., not c. y.

(Page 1658.)

ENGINEERS (Chief).—The 1906 references are 06, 766, 767, 787; and the 1910 references are 10, 968, 998.

(Page 1675.)

BELLINGHAM BAY AND HARBOR, WASH. (XX-103)

ENGINEERS (Assistants).—Capt. Francis A. Pope is correct.

(Page 1676.)

SPOKANE RIVER, IDAHO. (XX-107)

ENGINEERS (In charge).—Reference is to report for 1898.

(Page 1679.)

WRANGELL NARROWS, ALASKA. (XX-122-b)

PHYSICAL CHARACTERISTICS. — First paragraph. Omit reference to page 3157.

SURVEYS.—Fifth line. Omit "(length to be 300′)."

(Page 1680.)

YUKON RIVER, ALASKA. (XX-188)

SURVEYS.—Omit reference 12, 1267.

YY.—INSULAR RIVERS AND HARBORS.

(Page 1665.)

WATERWAY LIST.

Fajardo R. (YY-5) is preferable spelling.
Salinas R. (YY-9) is preferable spelling.
Bayamon R. (YY-28) is preferable spelling.
Hawaiian Islands: The following is another arrangement of the landmarks of these islands. (See copy on next page.)

HAWAIIAN ISLANDS, PACIFIC OCEAN.

YY 1 Kauai Isld.
YY 2 Hanalei B. (1)
YY 3 Kealia B. (1)
YY 4 Hanamaulu B. (1)
YY 5 Nawiliwili B. (1)
YY 6 Koloa Ldg. (1)
YY 7 Hanapepe H. (1)
YY 8 Waimea R. (1)
YY 9 Kumukahi Chan. (1) (10)

YY 10 Niihau Isld.
YY 11 Kii Ldg. (10)
YY 12 Kaumuhonu B. (10)
YY 13 Nonopapa Ldg. (10)

YY 14 Oahu Isld.
YY 15 Laie B. (14)
YY 16 Kahana B. (14)
YY 17 Kaneohe B. (14)
YY 18 Kailua B. (14)
YY 19 Waimanalo B. (14)
YY 20 Maunalua H. (14)
YY 21 Honolulu H. (14)
YY 22 Kalihi H. (14)
YY 23 Pearl H. (14)
YY 24 Pokai H. (14)
YY 25 Waialua B. (14)
YY 26 Waimea B. (14)

YY 27 Molokai Isld.
YY 28 Kalaupapa Ldg. (27)
YY 29 Halawa B. (27)
YY 30 Pailolo Chan. (27)
YY 31 Pukoo Ldg. (27)
YY 32 Kaunakakai H. (27)

YY 33 Lanai Isld.
YY 34 Kalohi Chan. (33) (37)
YY 35 Halepalaoa Ldg. (33)
YY 36 Manele B. (33)

YY 37 Maui Isld.
YY 38 Honokahau H. (37)
YY 39 Kahului H. (37)
YY 40 Keanae Ldg. (37)
YY 41 Pueokahi B. (37)
YY 42 Kipahulu Ldg. (37)
YY 43 La Perouse Ldg. (37)
YY 44 Maalaea B. (37)
YY 45 Lahaina Ldg. (37)
YY 46 Kaanapali Ldg. (37)

YY 47 Kahoolawe Isld.
YY 48 Kanapou B. (47)
YY 49 Smuggler Cove Ldg. (47)

YY 50 Hawaii Isld.
YY 51 Honoipu Ldg. (50)
YY 52 Awaeli H. (50)
YY 53 Waipio H. (50)
YY 54 Laupahoehoe Ldg. (50)
YY 55 Hilo H. (50)
YY 56 Kuhio B. (50) (55)
YY 57 Keauhou Ldg. (50)
YY 58 Punaluu H. (50)
YY 59 Honuapo H. (50)
YY 60 Kaalualu H. (50)
YY 61 Hoopuloa Ldg. (50)
YY 62 Kauhako B. (50)
YY 63 Kealakekua B. (50)
YY 64 Kailua B. (50)
YY 65 Kiholo B. (50)
YY 66 Kawaihae H. (50)
YY 67 Mahukona Ldg. (50)

(Page 1687.)

MAYAGUEZ HARBOR, P. R. (YY-90)

ENGINEERS (Chief of).—The 1907 reference is also 07, 807.

(Page 1688.)

HONOLULU HARBOR, HAWAII. (YY-45)

APPROPRIATIONS.—Reference to the 1905 item is 05, 2564, 2566.

(Page 1690.)

HILO HARBOR, HAWAII. YY-73)

APPROPRIATIONS.—Reference to 1912 item is 12, 2873.

PART VII

CONSOLIDATED FINDING LIST

VOLS. I AND II

United States Rivers and Harbors, Fortifications,
Bridges, Wrecks, and all other data
in Pages 1–2846 of this Index

ALPHABETICAL FINDING LIST.

NOTE.

The following list is, in the main, an alphabetical arrangement of the names of the waterways, harbors, or places of the United States, as found in Vols. I and II of this Index, with the addition of special references to data relating to fortifications, bridges, wreck removal, harbor lines, etc., as found in the two volumes of this Index. The names of special subjects found in the two volumes are also listed.

Each name is usually followed by (a) the district letter, (b) the district number of the waterway, and (c) the page number of this Index whereon further information concerning the subject is found.

This finding list does not contain references to special points embraced by a waterway, except in a few instances; as, for example, the instances of the Ohio, Missouri, Mississippi, and the Columbia. The abstracts concerning these waterways have their own indexes, and in this finding list the page reference is to the page of this Index whereon the special index contains the waterway or waterway point name listed herein. A star (*) follows the page reference in all these cases.

The Index has, as far as practicable, preserved the different spellings of waterway names. For example, on page 131 of this Index three different spellings are given of "Potonowut." These different names are listed herein.

The different names or titles given waterways have also been preserved. On page 318 of this Index "Smyrna River" is listed also as "Duck Creek," and this waterway is found under both titles in this list.[1]

COMPOUND WORDS.—Compound words are listed generally according to the initial of the first or prefix word. For example, Bay Pompadour is listed in the B's. The more generally used prefixes are Bay, Big, Bogue, Broad, East, Fort, Lake, Little, Lower, Middle, New, North, Old, Saint, San, South, Upper, West, White.

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[1] In the following finding list the class term "river" does not possess a definiteness of meaning found in words like "ocean," "lake," "bay," or even "gulf." There is an indiscriminate use of such words as "creek," "bayou," "river," "branch," "brook," and "slough." The reports have used the names popularly given to a waterway, so that the class name does not indicate the physical character of the stream as it might do were something like the following meanings to be applied to the terms referred to:

RIVER.—Streams with channel cross section for at least 1 mile from mouth equal to bearing two of the largest steamships moving side by side. (See Panama Canal dimensions on p. 2571 of this Index.)

CREEK.—Channel cross section for at least 1 mile equal to bearing but one of the largest steamships.

BAYOU.—Channel cross section for at least 1 mile equal to bearing a ship of not more than 100 tons burden.

BRANCH.—Cross section profitable for waterpower.

BROOK.—Cross section not practicable for waterpower.

The addition of Roman numerals following a class term of a stream could indicate its situation with respect to the final receiving body of water. *Illustration:* Delaware River (I), flows directly into the ocean. Schuylkill River (II), flows into a primary, or into the Delaware. Chicago River (III), flows into the Great Lakes (II), and the latter into the St. Lawrence (I).—J. McC.

GENERAL FINDING LIST.

A.

	District and No.	Vol. and page.
Abagadassett R., Me.	A-229	i, 29
Abaline Cr., Kans	GG-1322	i, 1035
Abbey Isld. Cr., Md	J-951	i, 338
Abbot Cove, Md	J-425	i, 334
Abbott Cr., Ky	DD-235	i, 961
Abbott Cr., N. C	N-50	i, 499
Abbreviations		i, 15
Abels B., N. C	M-42	i, 454
Aberdeen, Wash.:		
Harbor lines		ii, 2253
Aberdeen Cr., Md	J-1247	i, 340
Abiline Cr., Kans.:		
(See notes, p. 2822.)		
Abita R., La	S-23	i, 681
Abraham Cr., Pa	J-694	i, 336
Abrahams Bluff Cut-off, Ga	O-486	i,536
Abraham Lincoln House, D. C		ii, 2039, 2066
Abrams Cr., Tenn	AA-104	i, 849
Absecon Cr., N. J	I-18	i, 299, 303
Appro		ii, 2290
Absecon Inlet, N. J	I-17	i, 299, 303
	I-16-a	i, 303
Harbor lines		ii, 2253
Wrecks		ii, 2263
Academy Cr., Ga	O-445	i, 536
Academy of Sciences:		
Surveys		ii, 2041, 2120
Accomac Co., Va	L-85-b	i, 417
Accotink B., Va	K-96	i, 373, 390
Appro		ii, 2291
Accotink Cr., Va	K-96	i, 390
Appro		ii, 2291
Acoaksett R., Mass.:		
Bridges		ii, 2139
Acre Cr., Md	J-52	i, 331
Acts:		
(See notes, p. 2781.)		
Appro		ii, 2279
Acushnet R., Mass	C-54	i, 107
Bridges		ii, 2139
Harbor lines		ii, 2253
Ada Cr., Mont	GG-616	i, 1029
(See notes, p. 2817.)		
Adams B., La	S-328	i, 683
(See notes, p. 2804.)		
Adams Bayou, Tex.:		
(See notes, p. 2806.)		
Adams Branch, Mo	GG-112	i, 1026
(See notes, p. 2813.)		
Adams Cr., Ga	O-106	i, 533
Adams Cr. (inland waterway, Pamlico Sound to Beaufort Inlet, N. C.)	M-205	i, 471
Adams Cr., La	R-96-d	i, 647
Adams Cr., N. C	M-200	i, 455
Appro		ii, 2292
Bridges		ii, 2139, 2231
Adams, Ft., R. I		ii, 1808
Adams Isld., N. Y.:		
Harbor lines		ii, 2253
Adams Landing, Vt	E-82	i, 177, 203
Agate B. H., Minn	LL-14	i, 1269
(See notes, p. 2835.)		
Appro		ii, 2298
Agate B., Minn	LL-14	i, 1265
Agate H., Mich	LL-37	i, 1265
Agawam R., Mass	C-45	i, 107
Agei R., Wyo	GG-690	i, 1030
Agency Cr., Tenn	AA-78	i, 848
Agua Caliente Cr., Cal	TT-40	i, 1555
Agusan R., P. I	YY-180	i, 1686
Ahnapee H. and R., Wis	MM-25	i, 1320
Navigation rules		ii, 2041, 2107
Appro		ii, 2298
Ahnapee R., Wis	MM-25	i, 1297
Bridges		ii, 2139
Ahpah Cr., Cal	TT-195	i, 1556
Aisquith Cr., Md	J-1216	i, 340
Aitkin Co	(HH)	i, 1071*
Alabama:		
Forts		ii, 1801, 1816, 1965, 1970
Alabama and Tennessee Rs. (canal to connect)	AA-18-i	i, 868
Alabama Bayou, La	S-542	i, 685
Alabama R	(CC)	i, 909*
(See notes, p. 2801.)		
Appro		ii, 2294
Bridges		ii, 2139
Alabama R., Ala	Q-49	i, 611, 633
	R-22	i, 646
Alafia R., Fla	P-304	i, 571, 601
Bridges		ii, 2139
Alaqua Bayou, Fla. (bar at mouth of)	Q-36	i 628
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